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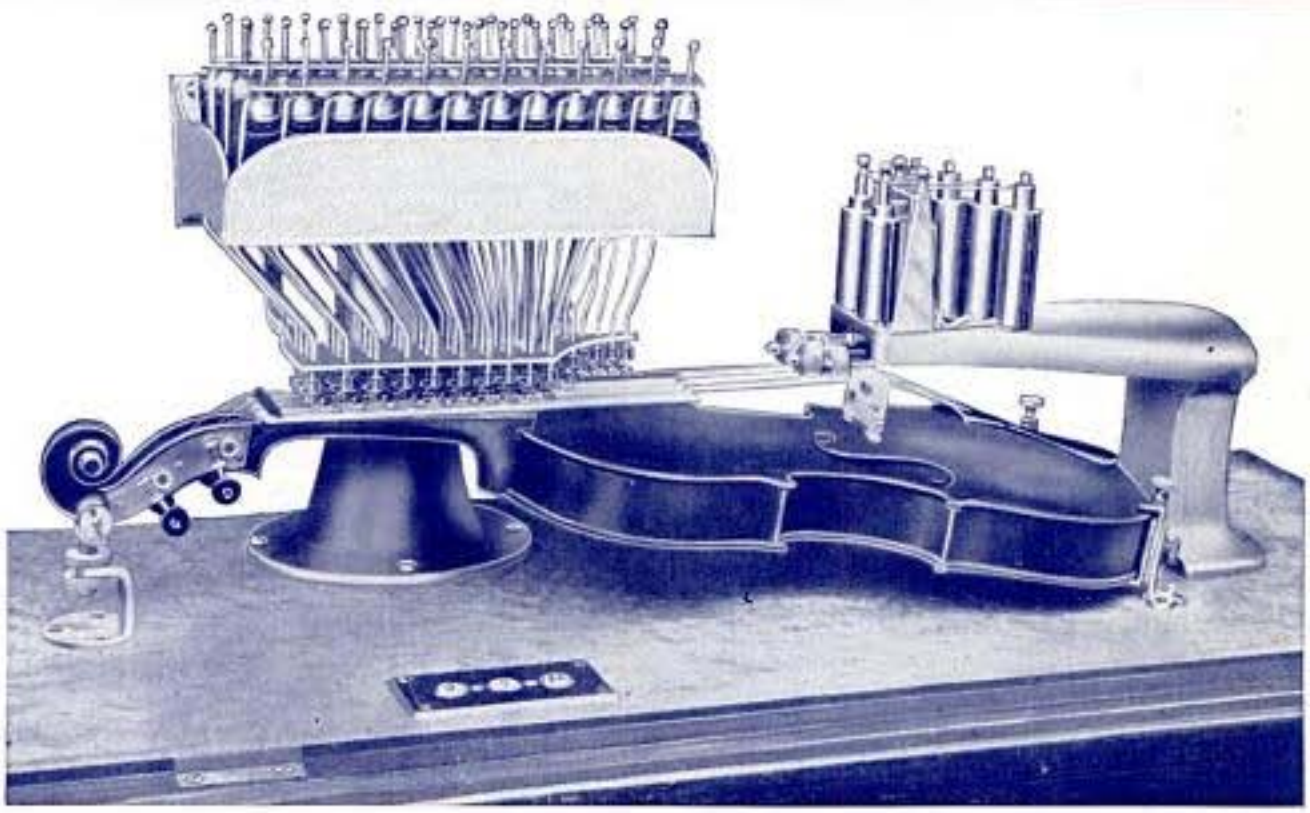

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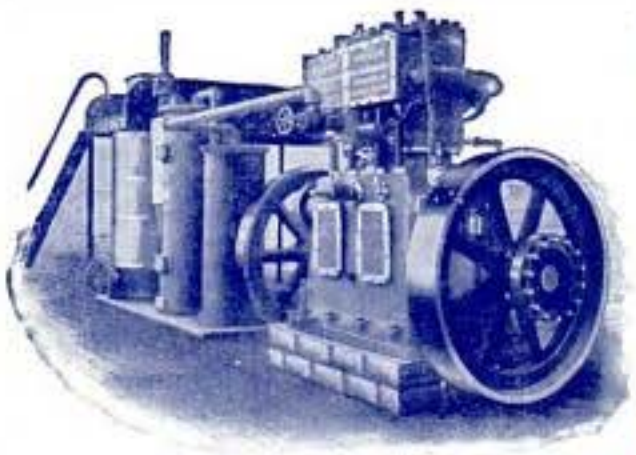

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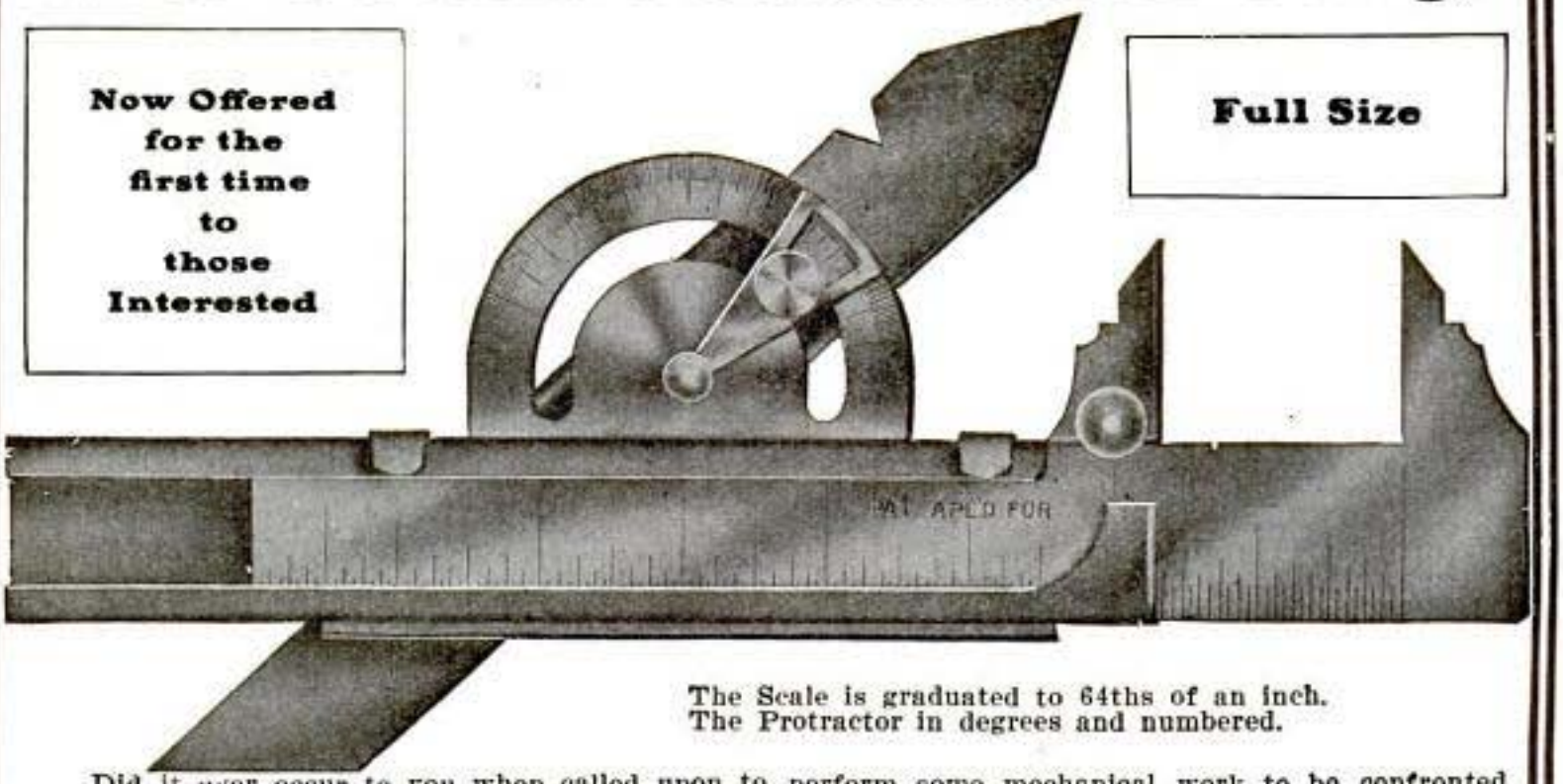


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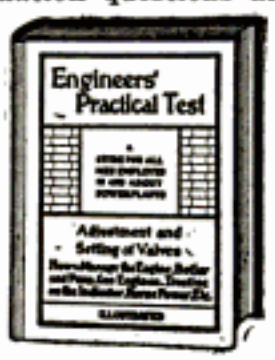



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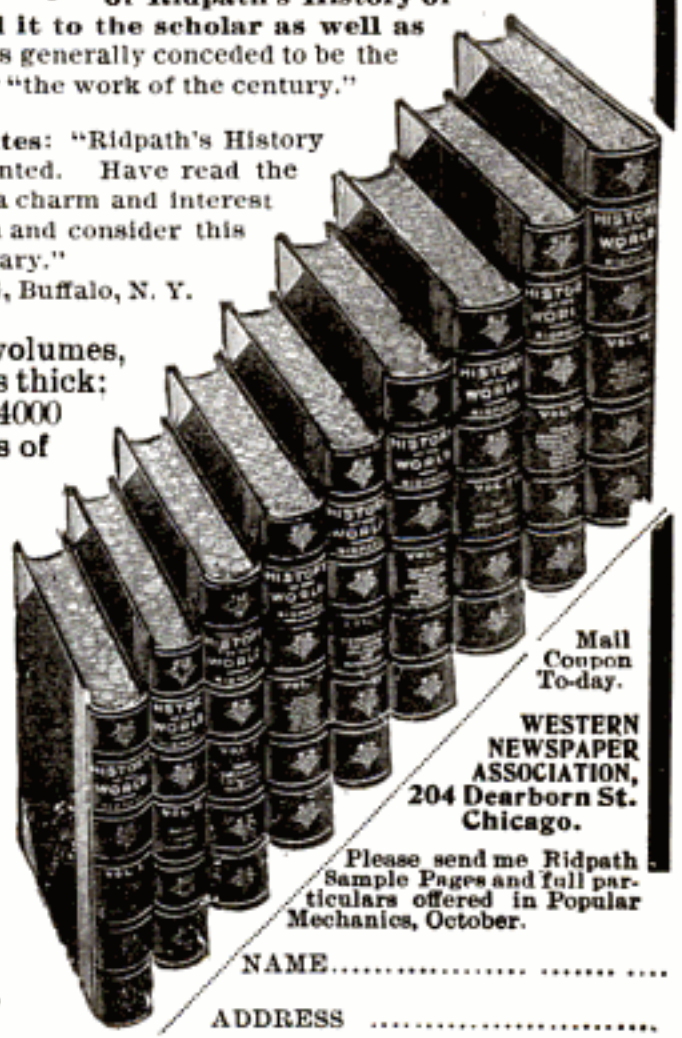

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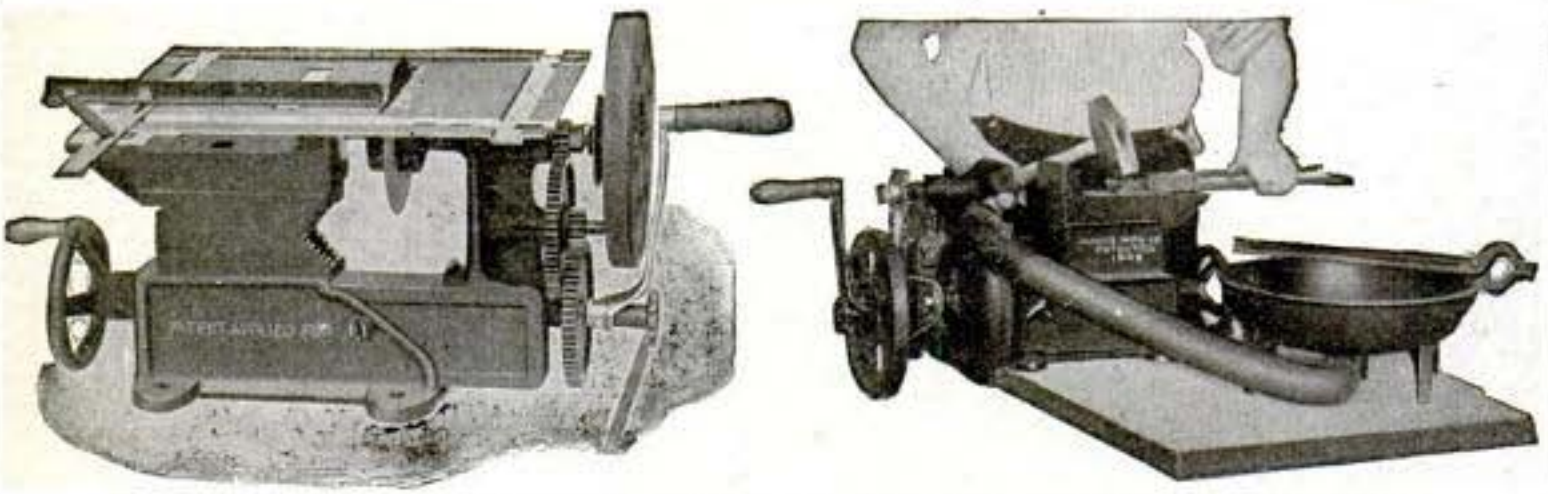

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Has cut gears, and may be operated by hand, foot or motor power. The 9-pound fly-wheel imparts wonderful speed and momentum. Not an ordinary, cheap "repair kit," but a real machine, made from the best of materials, and does absolutely true work. All of our attachments such as saws, emery-wheels and drills are the best standard makes. Our Machine-Tools are guaranteed both as to materials and workmanship. Big demand for them in towns and cities as well as in the country. Sold direct by the manufacturers to users at reasonable prices with liberal discounts to Manual Training Schools. Write for descriptive circular.

## MYERS MANUFACTURING CO., 65 Wabash Avenue, CHICAGO

# POPULAR MECHANICS

Vol. 7. No. 10. CHICAGO, OCTOBER, 1905. 10 Cents a copy. $1.00 a year.

# BURNING CARTRIDGES NOT DANGEROUS

**Startling Demonstration--The Men Who Make Ammunition Fearlessly Stand Near While 68,000 Rounds Are Consumed in Fierce Fire**

To prove their assertion that cartridges and shells may be consumed in roaring flames without danger to bystanders, a committee of ammunition makers stood within 20 ft. of a roaring fire in the midst of which were 68,000 rounds of the explosives. The tests lasted 30 minutes and no one was hurt.

This startling exhibition was made before the convention of the International Association of Fire Engineers, at Duluth, to prove the claim that firemen need not hesitate to come within working distance of a burning building containing cartridges and shells.

The demonstration was on account of the contemplated increase in insurance rates on buildings containing ammunition, such as hardware stores, etc. Previous to the fire, the following statement was made:

"Ammunition in a fire does not explode simultaneously. We make this statement advisedly and emphatically after many years' experience. Gunpowder in bulk, that is to say, in kegs, will explode with force. One keg exploding may tear open the adjacent kegs and the flash of fire from the first communicate to the second, and that in turn to the next, with such rapidity that the explosion is practically simultaneous. At first thought there would appear to be no reason why ammunition should not act in the same way, but as a matter of fact, it does not. An exploding cartridge has not sufficient force to tear open the adjacent

**Firemen Extinguishing the Fire at a Distance of 20 Feet During Rapid Discharge of Cartridges**

cartridge and therefore cannot communicate fire to the powder charge of its neighbor. Each cartridge in the fire explodes individually, and explodes when its particular primer is heated to the flashing point, but the flash from this cartridge cannot set off the adjacent cartridge. Consequently, instead of having a simultaneous explosion, we have a series of explosions of the individual cartridges, and when there is a large quantity of ammunition burning these explosions follow in rapid succession, sounding like rapid musketry fire.

"The danger from flying fragments of exploding cartridges is by no means a serious matter. The cartridge shell unsupported by the gun chamber readily bursts at the first indication of pressure, and this allows the gases to escape at a low pressure. The escaping gas expends its energy in tearing open the shell rather than in throwing the bullet, and as there is nothing to restrict the escaping gas, it has but little propulsive force. Frequently the heads of the cartridges are torn off and thrown some little distance, but the bullets scarcely ever fly. In other words, the heavier parts of the cartridge remain behind and only the lighter parts are thrown out, and they are thrown with no force or velocity; in fact, a fireman may keep well beyond the range of fragments thrown from the fire and still be easily within working distance and as close as the heat of the fire would permit."

The Western Fireman, whose editor was a close witness, states that for the test a frame building was constructed, in which was placed 68,000 rounds of ammunition. The cartridges ranged from 22 calibre to 50-110 high velocity kind. Also shot shells loaded with black and smokeless powder, and rifle and pistol cartridges of various kinds. The house was made as combustible as possible with a chimney on the roof extending 6 ft. above. The building was then filled with excelsior and fine dry wood and set on fire, and to insure a hot, rapid fire, 5 gallons of kerosene was poured on the mass. The ammunition had been unpacked from the wooden shipping cases and remained in pasteboard boxes, just as it is displayed in a store.

At the end of twenty minutes half the ammunition was destroyed, and the firemen tore some boards from the side of the house and put out the fire. The test proved all the ammunition makers claimed. Several persons who approached within twenty feet of the fire were struck by flying fragments of cartridges, but in no case was the velocity of the pieces sufficient to cause discomfort. In other words the bursting of the cartridges was not unlike the popping open of corn or chestnuts when heated.

The exhibition was conducted by the Winchester Repeating Arms Company, the Union Metallic Cartridge Company, the United States Cartridge Company, and the Peters Cartridge Company.

## AUTO TRACK RACING TO CEASE

Indications are that the auto track racing will be abandoned, in this country at least, so far as the better class of people are concerned. One fatality after another of enthusiastic auto men has brought about the result.

Ex-Chairman Temple, of the American Automobile Association, states the case concisely as follows: "I don't believe in the racing game anyway. I can see no utility in it. It does not demonstrate anything of value to the true automobile sport


Motor Age

**"Toying With Death"**

or to the industry. The mere matter of speed does not need demonstration in that way. Every one knows that automobiles can be built to run faster than they can be driven with safety, so what is the use of such contests."

This sentiment finds echo from prominent auto club men all over the country and will doubtless result in action.

# AUTOMOBILE COMBINATION CHEMICAL FIRE ENGINE AND HOSE WAGON

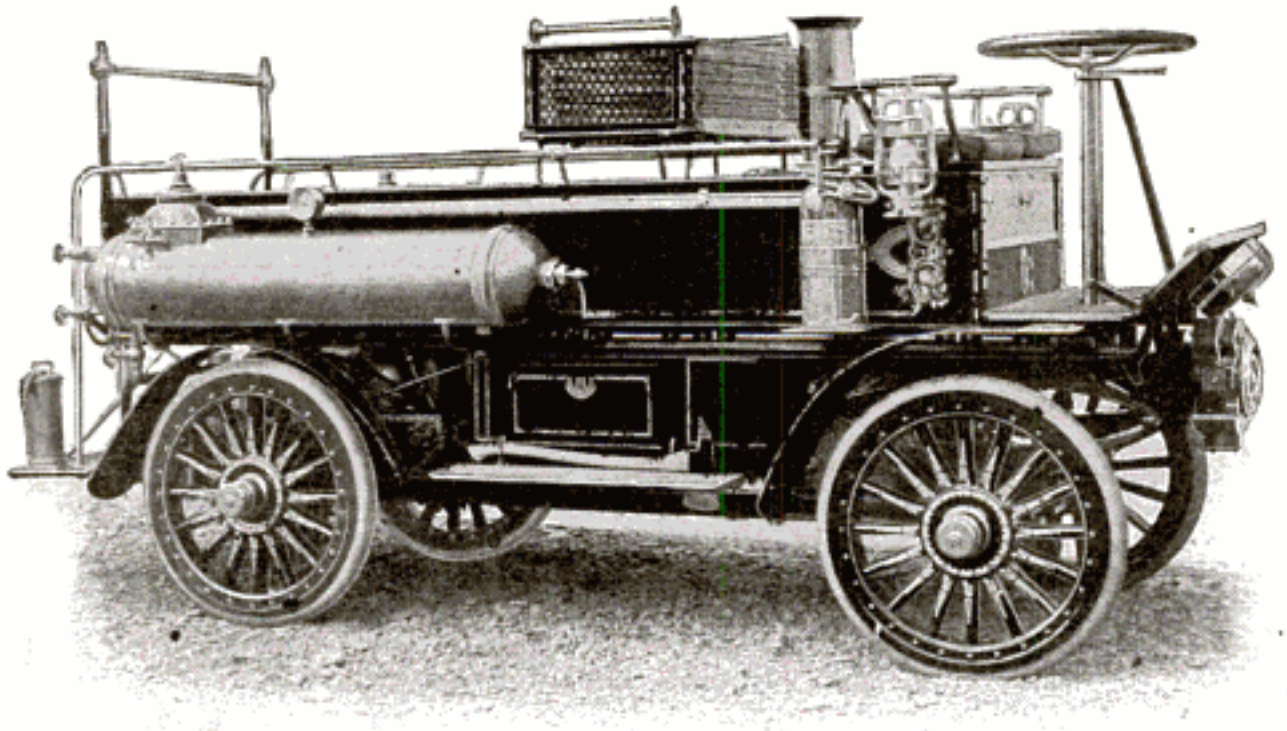
A new invention in the line of fire protection apparatus is a combination chemical fire engine and hose wagon using steam for its motive power and always ready to start at the sound of the alarm, merely upon the motorman mounting to his seat and opening first the fuel valve and then the steam throttle.

The combination wagon is built with an iron body on a channel steel frame and the body is mounted on four elliptic springs. The wheels are small and rubber-tired. The machine has capacity for 1,000 ft. of 2½ in. cotton rubber-lined hose, has a 35-gal. chemical cylinder on each side fully fitted up, and the equipment throughout is large and complete.

The fire-tube design of boiler is used, because of its great reserve power, useful in climbing hills or traveling over rough roads. When the apparatus is in motion on the street, gasoline is the fuel used, and at the engine house steam pressure is maintained by a gas burner. The gasoline burner is built entirely of steel and is controlled by regulators. Two engines, working independently, are connected, one to each rear wheel, for driving the machine. These engines are of the double-cylinder type, high-speed and double-acting.

The running gear has an 8-ft. base and 56-in. tread. The wheels are 36 in. in diameter with 4 in. solid rubber tires, provided with bolt head and protecting flanges.

The machine is very strong, capable of maintaining uniform speed on long runs, can be stopped quickly and is declared to be cheaper, all items considered, than the horse-drawn combinations. New London, Conn., is the first city to install one of these machines.



"Always Ready to Start"

## CLAY PRODUCTS A GREAT INDUSTRY

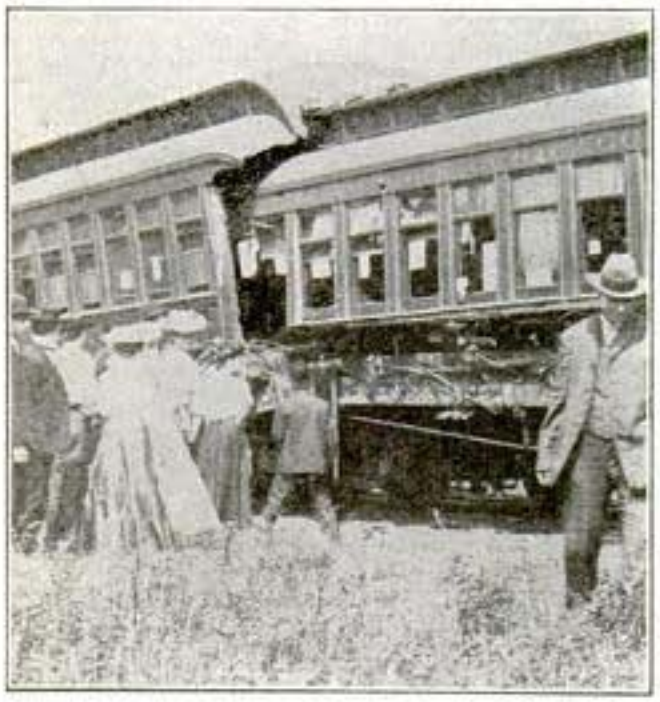
There are in this country 6,069 concerns engaged in converting clay into manufactured products; the average output for a year being $21,589; the total value amounting to $131,000,000 for twelve months. Of this the greater part was brick and tile, valued at $105,000,000. The leading producing states in their order are, Ohio, Pennsylvania, New Jersey, Illinois and New York. Ohio shows a record of over $25,000,000.

The average price throughout all the states was for common brick, of which 8,665,000 thousands were made, $5.97 per M.; paving brick sold for an average of $10.28.

Sand-lime bricks now seem to be considered a success; 57 plants earned $463,000. The rapid increase in the use of cement blocks is likely to reduce the volume of clay products, or at least to curtail their previous yearly increase.

## FREIGHT AND PASSENGER COLLISION

The effect of a head-on collision which recently occured on the Nickel Plate road, near Cleveland, is vividly portrayed in the illustrations. Twelve persons were killed and many more injured; the greatest harm



**Telescoped**

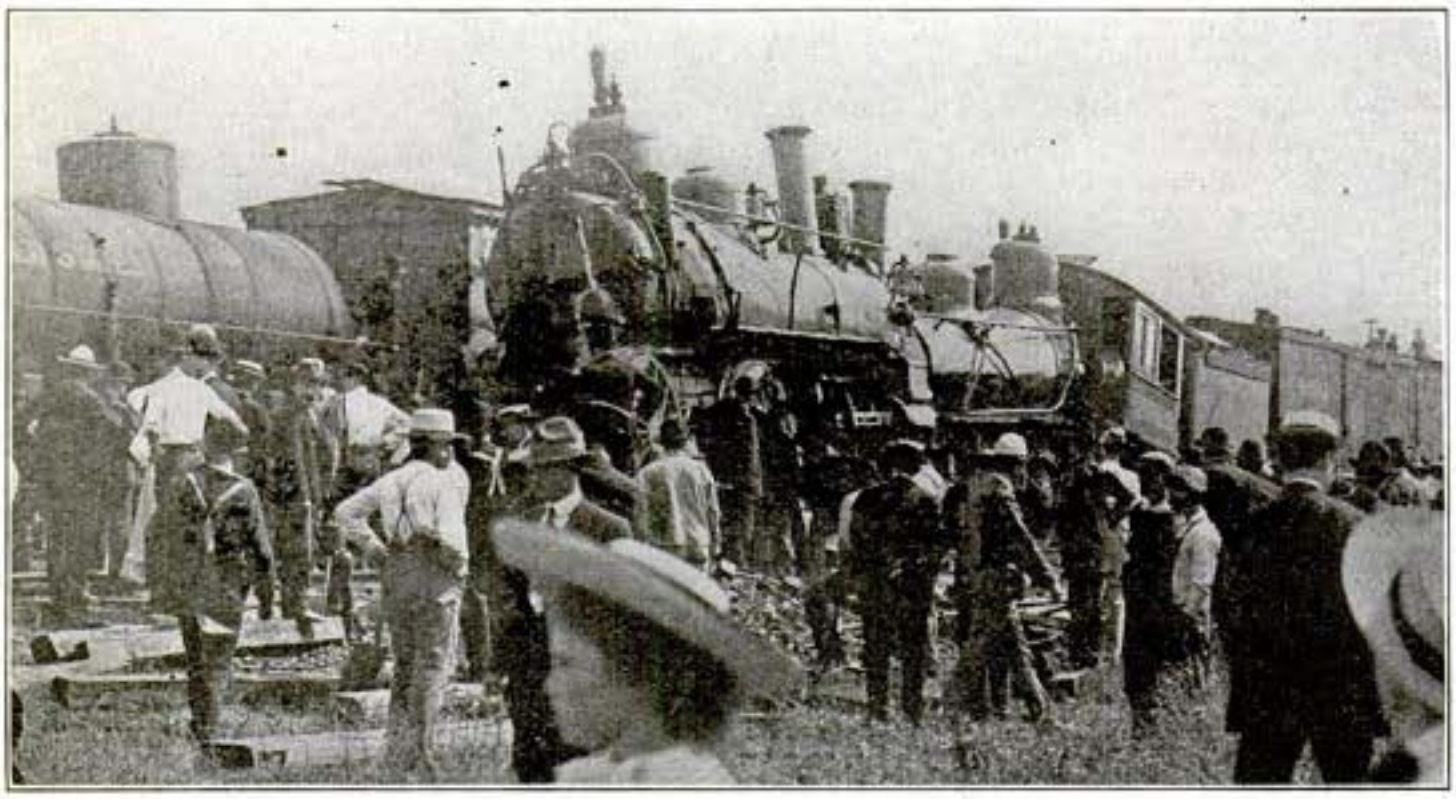
was done to those in the smoker which was telescoped. A fast passenger train running 50 miles an hour ran into a freight train which was standing still. Failure of the freight crew to obey orders and further neglect in flagging the flier caused the accident. Engineer Poole of the passenger refused to jump, was caught in the wreck and slowly scalded to death before the eyes of a helpless crowd.

## TRANSPORTATION OF BANANAS

One company alone imported 26,000,000 bunches of bananas in a single year, requiring 72 steamers. The transportation of the fruit is peculiar; it must not get too warm or it decays, nor too cold or it will never ripen, it being always shipped green. The latest improvement is the erection of cooling sheds, into which an entire train is run at one time, and cold air is pumped into the tops of the cars, thus reducing the temperature to exactly the degree desired. In winter warm air will be used. The blower has a capacity of 50,000 cu. ft. per minute, and an electric alarm in each car rings a gong when the proper temperature is reached.—Condensed from Ice and Refrigeration, Chicago.

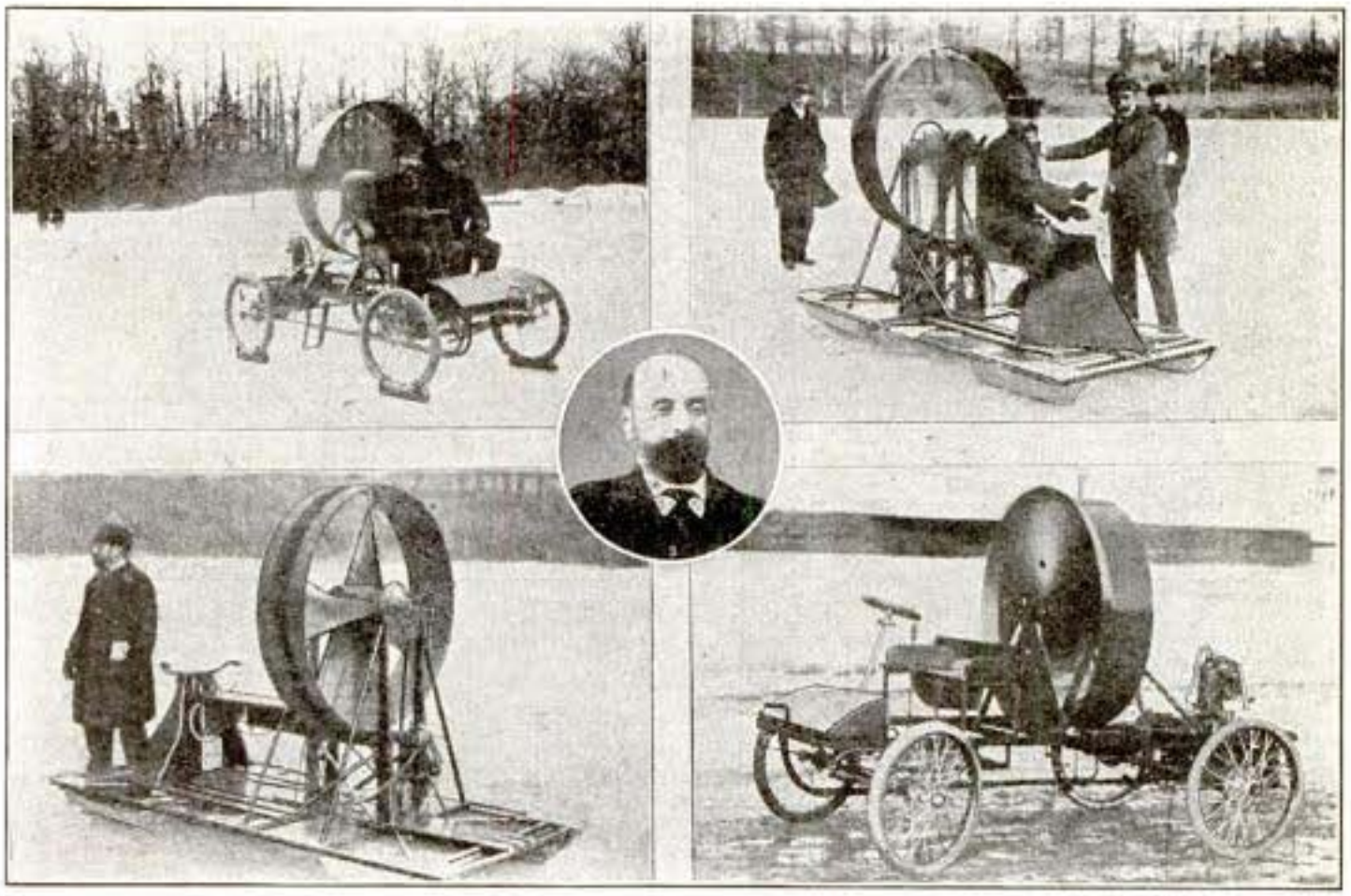
## SECRET TELEPHONE EXCHANGE

An electrical expert has invented and put in practical operation, a telephone exchange in which the hello girl cannot listen to the conversation. The next encroachment on official perquisites will be a postal card which cannot be read en route. The system of switchboard wiring by which this is accomplished is said not to be specially complicated.



**"The Passenger Train Was Running 50 Miles An Hour"**

# FAN-DRIVEN ICE VEHICLE



**The "Aëro-Motor"--An English Ice Craft that Will be Tested During the Coming Winter**

Motor ice yachts and ice vehicles of all types will, beyond doubt, create great interest during the coming winter. Among the many machines which will be tested is an English device called an "aëro-motor," and will utilize an idea tried in this country several years ago—that of propelling the sledge by means of a revolving fan or screw.

The fan used in the English machine is four-bladed, is driven by a gasoline engine and may be attached to either a motor-car or to a sled. The inventor, J. Bruce MacDuff, expects great things of his machine and suggests that the aëro-motor sleigh may supplant dogs for use in Arctic and Antartic explorations.

# SUPERINTENDENTS SHOULD SUPERINTEND

It is of the highest value to have a superintendent who possesses the practical knowledge and experience to do any piece of work which comes into his shop. To have him take off his coat and do the work except in the case of some unusual thing where he does so to show his men how, is not considered advisable.

In a paper read before an association of foremen the superintendent of motive power of the C. & N. W. Ry. says:

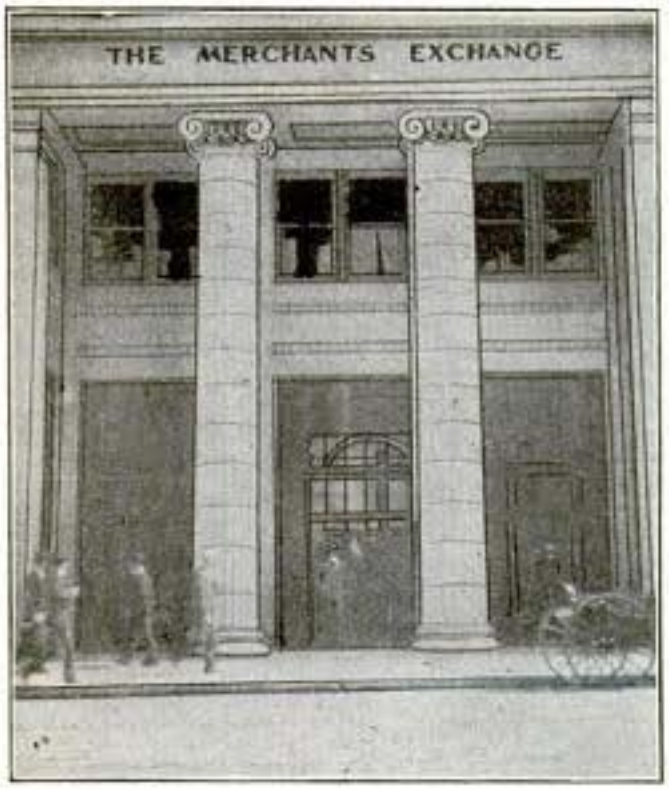
"You men have no business to have your coats off when on duty in your shops unless you are warm. You have no business to take the tools out of a workman's hands to do his work. Your business is to secure results from the other men's work. If I find that a foreman boiler maker on my road is doing the work that his men ought to do I begin to think that he had better keep using the hammer and chisel."

Ability to do things is all right; the doing of them is another matter. Proprietors make a mistake when they allow or expect a superintendent to work with his hands when he ought to be working with his head. It's an extraordinary man who can do both successfully at the same time, and such men do not remain superintendents very long.

## GRANITE COLUMNS WITH STEEL CENTERS

**Unique Combination of a San Francisco Architect**

The Merchants Exchange new building in San Francisco possesses a remarkable feature, which so far as we can learn is the first of its kind. The massive granite pillars which support the great building are hollow and contain solid steel columns.




**Steel-Centered Granite Columns 40 Feet High**

This building is fourteen stories high; the two lower stories are of granite and the other twelve of very handsome pressed brick On each side of the main entrance are two enormous fluted granite pillars. At the base each pillar is 6 ft. in diameter; they taper slightly and are 5 ft. across at the top; each being 40 ft. high.

Before the massive and shapely columns were put in position, when the great building had reached the first story, both the contractors and architect concluded that they should be strengthened in some manner. Massive though the granite pillars would be, yet the weight they were required to support was enormous.

To increase the strength it was determined to build the pillars in short sections and to bore out a hole in each section 16 in. in diameter. This long hole of 40 ft. was to contain a solid steel column 16 in. in diameter. It proved a slow, tedious, and painstaking task to cut a hole through the blocks of granite. This was accomplished by means of a circular saw, the core being "trepanned."

The cutting was done with the utmost precision; so very accurate that the sections fitted together with the utmost nicety, the flutings being perfect. As each section was bored out it was lifted by a derrick and fitted over the steel column. Whatever little space was left between the steel pillar and its granite casement was filled with liquid cement. This, hardening, made one solid mass.

The two columns were then placed in position, and the building proceeded. Each pillar contains 13 sections, the joints being united with cement.

That the building has sufficient support is not denied, though some architects question the utility of the plan, claiming that it is extremely difficult to divide the load between steel and granite, the resistance of the two not being equal. "One or the other is really carrying the load," says a prominent Chicago architect, "although the steel center undeniably holds the circular stone sections that compose the pillar in place."

## ARMY MOTOR WAGONS WITH WOODEN WHEELS

Built strictly for business and with no consideration for the comfort of the passengers is true of the new army motor wagons built for France. However, they carry great loads at a speed of 15 miles an hour on good roads, and are guaranteed not to stampede under fire. The latest type have wooden


**Army Motor Wagon**

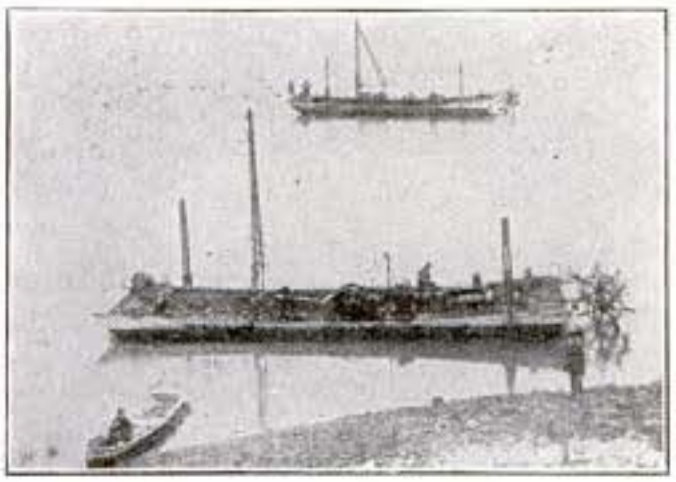
wheels with immense spokes and wide steel tires, which meet the approval of military men as safer than any form of rubber tires. The Motor Age says the steel tired wheels proved good hill climbers even in the mud.

## ZIRCONIUM, NEW FILAMENT

A new filament for incandescent lamps is produced by submitting oxides of a material called zirconium and magnesium at a high temperature to the action of hydrogen, then pulverizing the resultant alloy and adding a cellulose solution which transforms it into a plastic and homogeneous mass. From this mass the filaments are drawn, 50,000 to the pound of raw material. The zirconium lamps require current of only 37 volts and three lamps can be placed in series across the usual 110-volt circuit. Several filaments in one bulb are used for high candle power lamps.

## MAPS OF RIVER BEDS

The foundations for a great bridge or dam are important essentials, which, like the engineers and firemen on a ship are not seen and seldom appreciated. Before the stately structure can span the chasm or stream the foundations must be laid deep,



**Boats for Drilling**

and sure, and lasting. There's a lesson here for every young man, but we are writing about dams and things—not preaching.

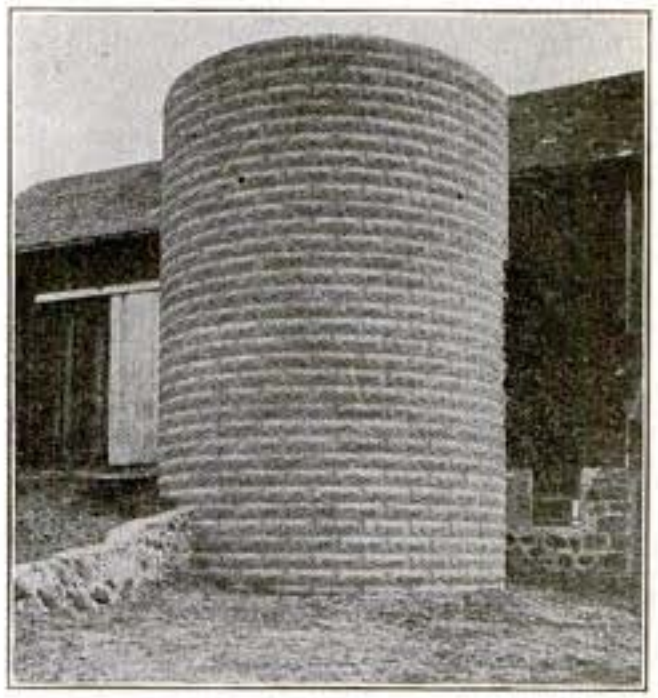
Weeks and months, sometimes even years, must be spent in studying the sand or rock beneath the water. Recently the government had occasion to learn the exact condition of the river bed of the Ohio for a mile and a half, near Parkersburg, W. Va. Scores of borings were made, each one furnishing its "core" from which exact maps were made showing exactly the character of the river bottom, and of the rock beneath to a considerable depth.

The illustration, from the Gas Engineer, shows the boats used in the sounding, the drills being let down into the water from the sides of the boats, and operated by gas engines.

## CEMENT BLOCK CIRCULAR SILO

The latest in the silo line is the handsome structure shown in the illustration. The following details are condensed from Hoard's Dairyman:

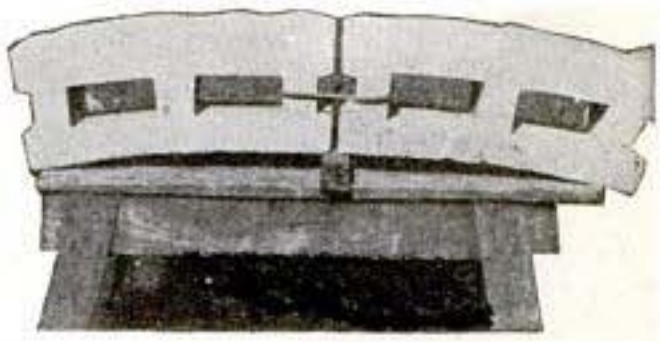
The silo is 29 ft. in height and 16 ft. in



**Cement Silo**

diameter and is figured to hold 115 tons. Its cost is $360. It is constructed of hollow cement blocks molded to the desired curve. The form and method of tying the blocks together so as to resist the lateral pressure, is shown in another cut.

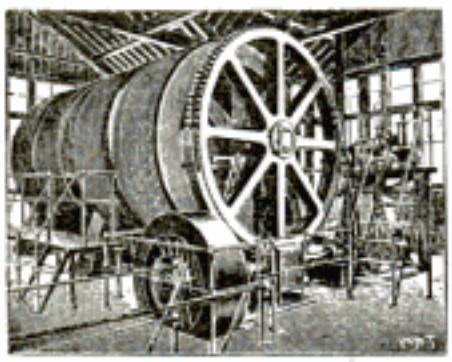
So far as we can judge, this is, in many respects, a model silo. If it proves to be all the designer and owner of it anticipate, under the test of time, it solves the problem of a cheap, safe and indestructible silo. The cost per ton of storage capacity is certainly reasonable. The device for strengthening the blocks appears to be sufficient. When laid up the notches in the ends of the blocks are filled with soft cement, which helps materially to make the wall strong.



**End View of Cement Blocks, Showing the Curve and Method of Applying the Iron Fasteners**

# CANAL BOATS WITH LOADS ELEVATED 75 FEET

## Unique English Elevator Saves 12 Locks-- Very Cheap to Operate



Power House



Lower Level Canal, Showing Lifting Cradles

An apparatus has been constructed at Foxton, England, which transports boats of all sorts from one canal to another seventy-five feet higher, without the use of locks, twelve of which would be required to raise a boat that distance.

Two docks with reservoirs of water are placed at the edge of the canals, one at the foot and the other at the top of an incline. Upon this slope are laid two tracks, each track composed of four rails. On these travel two cars for transporting the boats, one mounting while the other descends, being drawn by steel cables which run in conduits. The cars are, in fact, immense movable tubs formed of steel plates, well braced, and mounted upon sixteen pairs of strong wheels each. At either end of these traveling docks are sluice gates moved by hydraulic pressure. The power plant is installed at the top of the incline which is built of solid masonry.

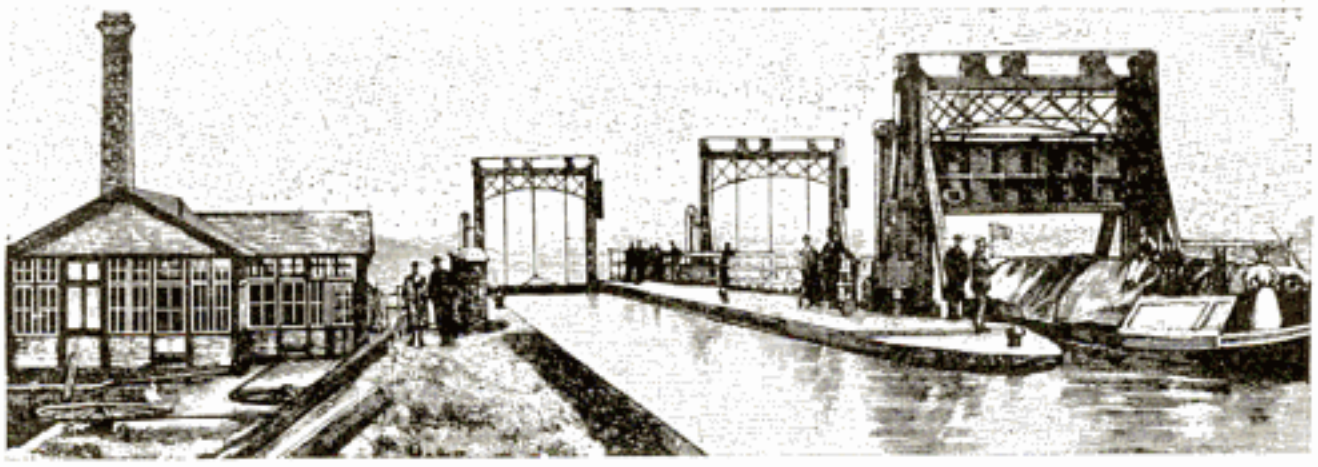
When a boat is ready to be transferred the car is submerged, one of the sluice gates at its end is opened and the boat sails into the metal dock with all its freight and appurtenances just as it floated in the canal. The gates are then closed and the boat is ready for its journey on the rails. When the other movable dock has been loaded in the same way one huge tub with its floating load is drawn up while the other carrying the second boat descends, thus, the weights being equalized, the cost of transferring the two boats is no more than to handle one alone. In order to launch the boats it is only necessary to open the sluice gates after the car has been again submerged, when they float out into the canal and resume their voyage. The whole operation, as previously mentioned, takes only 15 minutes.

The cost of operating this plant is quite insignificant. The boats are small, but the traffic has averaged a total of 6,000 tons handled each 12 hours; this cost only $6.40 for labor, fuel, oil and repairs. These traveling docks will accommodate canal boats up to 53 tons.

From 190 to 200 boats of that class was a fair average number during 12 hours without crowding, not counting canoes

motor-yachts and pleasure boats of all sorts which were transported during the same period.

To what extent it might be possible or practicable to enlarge the Foxton method is not yet known. If it could be adapted to large work such as the transport of great ocean vessels or a battleship, it would mean the saving of several years in time and a great many million dollars in money in the completion of the Panama canal. The question of levels and locks would then cut no particular figure, as there could be several levels, thus saving a vast amount of cutting and excavating.



**Upper Level Canal--Boats Proceeding on Journey**

## RAILROAD TRACK OF THE FUTURE

Increase of speed in the movement of passenger and freight trains seems to come in cycles of a few years each. It is not so many years ago that 29 hours were required to cover the 1,000 miles between Chicago and New York. Then the time was reduced to 24 hours, next to 20 hours and finally to 18 hours. When the electric motor replaces the steam locomotive for passenger trains this time will again be considerably reduced, but in all probability not until a radical change is made in track construction.

The high speed track of the future will be laid on longitudinal supports, instead of cross ties, and the foundation will be much deeper and more solid than is possible with wooden cross ties.

The New York Central is to have an electric locomotive of 2,200 h. p. which will be capable of hauling a heavy passenger train at 90 miles an hour. As it would have no occasion to stop for fuel or water, and seldom for other reasons, it will be seen that a road electrically equipped between Chicago and New York could make the run, so far as motive power is concerned, in a few minutes more than eleven hours, and it is not beyond possibilities that 100 miles an hour may be achieved. When this is done a man could leave New York at 9 o'clock in the morning, go to Chicago, spend an hour there, and be back in New York at 6 o'clock the next morning.

Many experts anticipate a return to the longitudinal system of track support, which will doubtless be in the form of a great beam of concrete which in turn will rest upon a support more solid than dirt.

In the early days of railroads in England, Germany, and even this country, the longitudinal system was employed, though by no means as substantial as is required with the mammoth locomotives and heavy sleeping cars of today. The increasing scarcity of wood for ties will also contribute toward a radical change in track construction.

The Engineering News, a railroad authority, says: "An engineer would never design an important building and support it on wooden blocks bedded a few inches below the ground surface; and he would not consider the case much better if stone or concrete blocks were substituted for wooden. To make a permanent support for railway track we must carry our foundation course down deeper, just as we would a building foundation. But it is practically impossible with the cross-tie system to make the foundation much deeper than the thickness of the present wooden ties, for the trackmen could not reach under the ties to tamp them if the ties were, say, 12 to 16 inches in depth. There is not room enough between the ties to permit this; and it is, of course, out of the question to space the ties farther apart. All this points directly to the replacement of cross-ties with longitudinals whenever a really permanent system of track foundations replaces the present 'mud-sill' system."

# THREE ACRES OF ROCK BLOWN UP

**Henderson's Point, Piscataqua River, Demolished by Forty Tons of Dynamite--Clearing the Channel to the Portsmouth Navy Yard**

A short time ago Henderson's Point was a big ledge of rock jutting out into the Piscataqua river and forming a sharp turn in the swift current, so that none of the larger warships could pass up the channel to the new dry-dock at Kittery, Maine. Today Henderson's Point lies a great mass of loose debris, which is being rapidly removed by powerful dredges. Forty tons of 75 per cent dynamite were used to reduce the 35,000 cubic yards of rock forming Henderson's Point to this condition and the entire project will cost the United States government $750,000. Since, in 1885, Hell Gate channel, East river, New York, was cleared of its dangerous rocks, there has been no blast to compare with this one. The Hell Gate blast, however, extended over an area of nine acres, and to break up the 270,000 cubic yards of rocks, 120 tons of "rend-rock" powder and 20 tons of dynamite were used.

The difficulties attending the destruction of Henderson's Point were great. The use of a coffer-dam had been intended, most of the work to be in the open and proceeding from the channel toward the shore, but the swift current wrecked the strong coffer-dam constructed and then one was built on top of the "rim."

The core was first excavated and just below the Point a submarine drilling boat was used for drilling holes where the shallow water began. The rock was blasted off into deep water and left for the time being. After three months' work, scows were substituted for the boat, and in all 800 cubic yards of rock were removed in this way.

The center of the Point removed, the work of putting in long holes for the big charge was begun. These holes were run from the edge of the "rim" at intervals of 6 to 10 ft. and at a dip from horizontal of 1¼ in. to the foot. The holes were from 50 to 80 ft. deep. Eight drills, having cylinders 5½ in. in diameter by 8-in. stroke, were used. The use of tripods or columns for mounting them was impossible under the conditions. Instead they were bolted to a heavy timber framework which was loaded down with stone. A series of holes were bored and the framework moved along. The holes at the start were 5 in. in diameter and tapered to 2 in., and the shortest time required for drilling one of them was 12 hours. The drills were operated by compressed air.

The great explosion caused no injury to persons or damage to property, beyond a few broken window panes, though water and debris were thrown to a height of 100 ft.

**Battery of Air Drills Inside Coffer-Dam**

# HOW AN AUTOMATIC SPRINKLER WORKS

### Inactive for Years, Perhaps, It Springs Into Action When Needed

We have had several requests for a description of the automatic sprinkler—a device which will remain inactive for months and years at a time, and then in an instant when fire breaks out in some remote room, drenches the compartment with water and subdues, even if it may not entirely extinguish the fire. Many a time a fire has been extinguished at the start, which if unchecked for a few minutes would have grown into a terrible conflagration.

The system is in reality a very simple affair, consisting of a big tank of water placed higher than the building, connected to parallel pipes extending along the ceiling of each room. These pipes are ordinarily 8 or 10 ft. apart, while at intervals of 10 ft. a sprinkler is attached to the pipe. By this arrangement at least one sprinkler is placed over each floor space of 8 x 10 ft.

The sprinkler itself consists of a metal frame with two bronze levers holding a bronze cap over the opening in the pipe. These levers are connected by a small link of solder, designed to melt at a temperature of 165 deg. As soon as a fire starts the hot gases and smoke rise to the ceiling, melt the solder, the levers are released and drop, there is no longer anything to hold the cap in place, it flies out, forced by the pressure of the water, and the sprinkler is busy. In order to spread the stream in all directions and divide it into large drops, a deflector is provided at the top of the frame. All these working parts will be clearly understood from the illustration (Fig. 1). The water will continue to run until some one shuts off the supply or the tank runs dry.

There are two sprinkler systems—the wet, in which the pipes are constantly filled with water; and the dry, in which there is no water in the pipes except when one or more sprinklers open. In the dry system

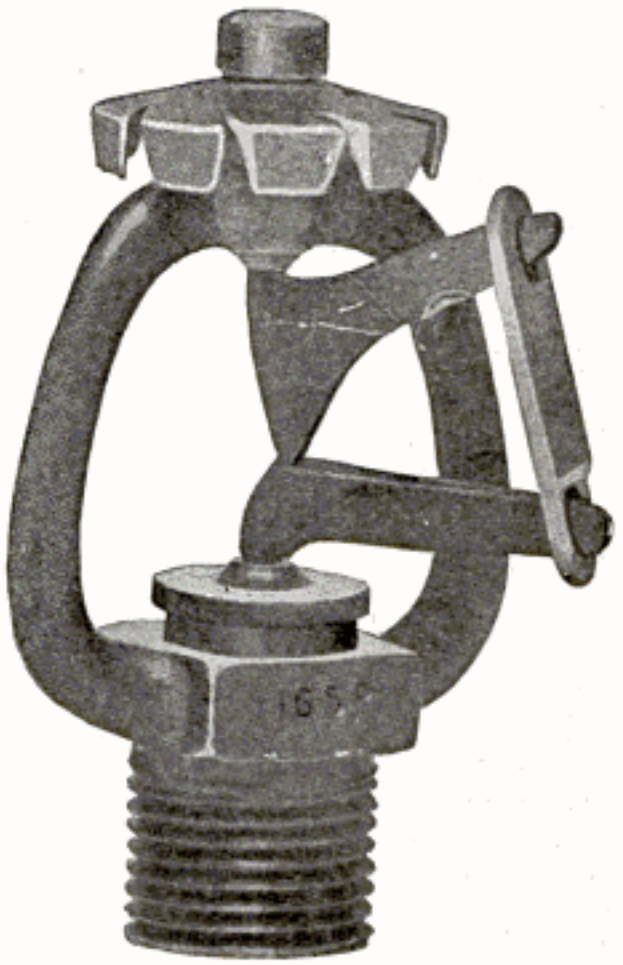
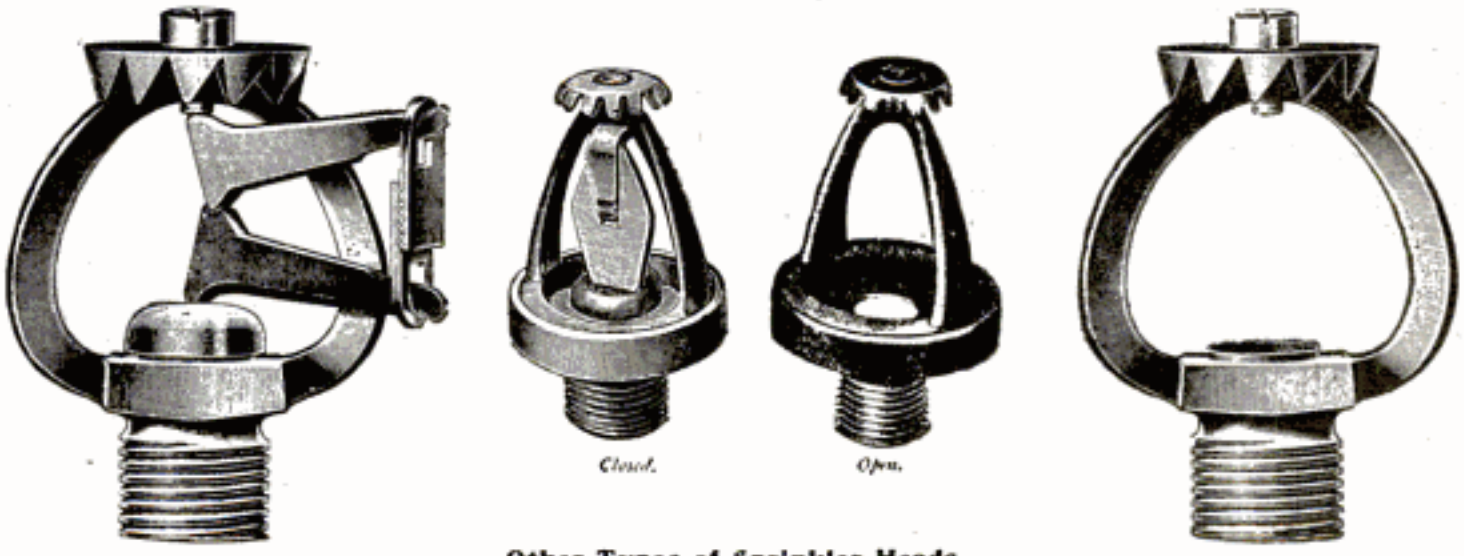


Fig. 1—Sprinkler Head

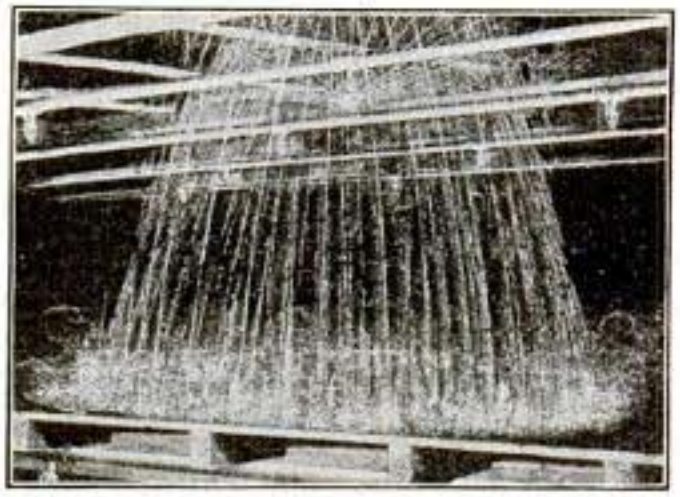
the pipes are filled with air compressed to about 30 lbs., which holds back a valve placed in the large water main leading from the tank.

Sprinklers are made to act at different temperatures as desired, from 165 deg. up to




Other Types of Sprinkler Heads

360 deg. This is accomplished by using links of various degrees of hardness. Each fuse link bears the date when it was put in, and its melting temperature.



**Sprinkler in Action**

Modifications of the above system include underground cisterns, instead of elevated tanks, or connection to city mains, in which case automatic pumps are required which start pumping the instant a sprinkler opens. A sprinkler system is quite expensive to install, but secures reduced insurance charges.

## POMPEII'S WATERWORKS

A most complete system of water works, says Professor Kelsey, Ann Arbor, Mich., has recently been unearthed in Pompeii. This system has been so well preserved that even at the present day it is possible to turn water on and it will flow through the pipes as freely as when that city was in the height of its prosperity over 1,800 years ago.

## A LAMPLESS LIGHTHOUSE

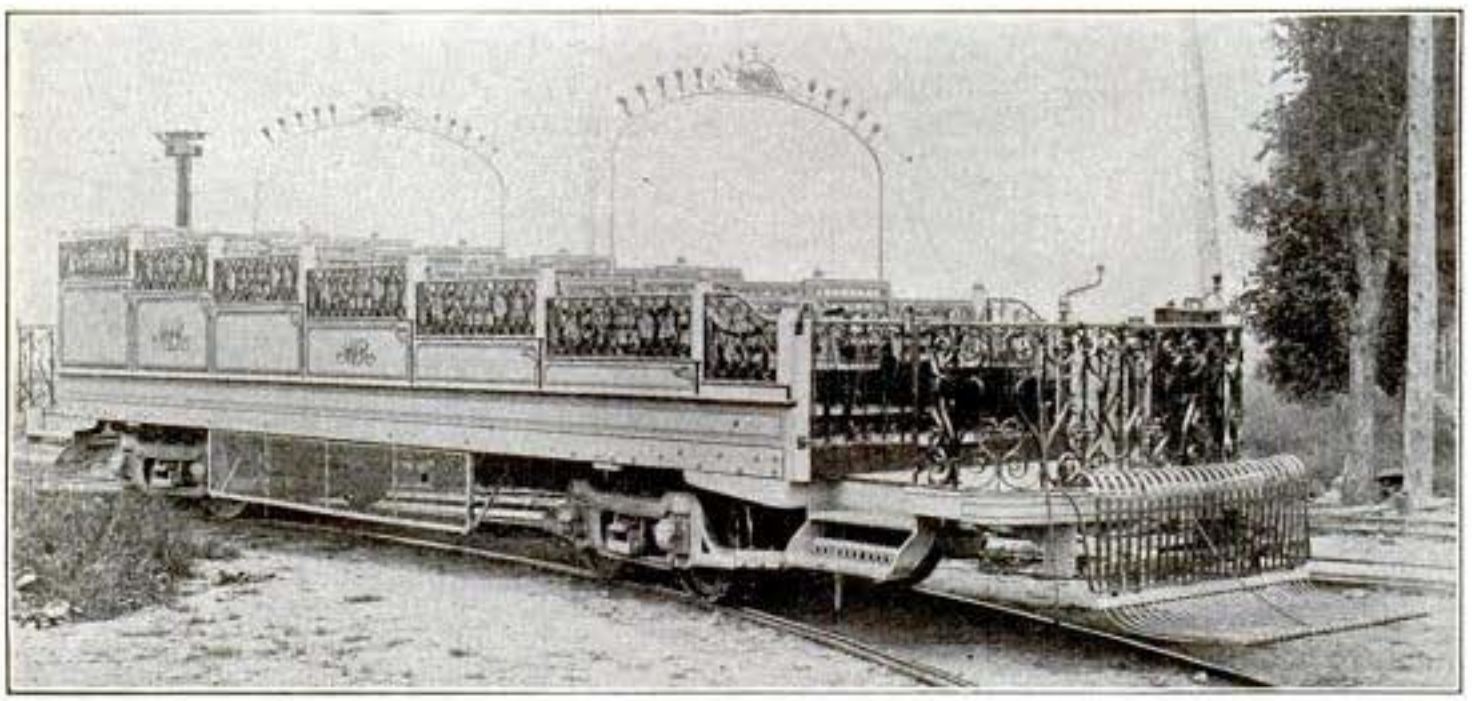
A lighthouse that has neither lamp nor keeper, yet throws out a light at night that may be seen far and wide upon the surrounding water, is located at Arnish Rock, Stornoway Bay, in the Hebrides, Scotland.

It is a conical beacon with a lantern, which has a mirror and an arrangement of prisms, fixed at its summit. Across the channel, 500 ft. away, on Lewis island, stands a lighthouse which throws a stream of light on the mirror in the lantern, which in turn reflects it on the prisms. The rays of light are converged to a focus outside the lantern and then diverge in every direction, making a serviceable lighthouse, fully adapted to the requirements of its locality.

## OBSERVATION STREET CAR

What is doubtless the finest observation street car in the world has just been built for the Montreal street railway. It makes daily trips, taking visitors over all the car lines in that extremely interesting city.

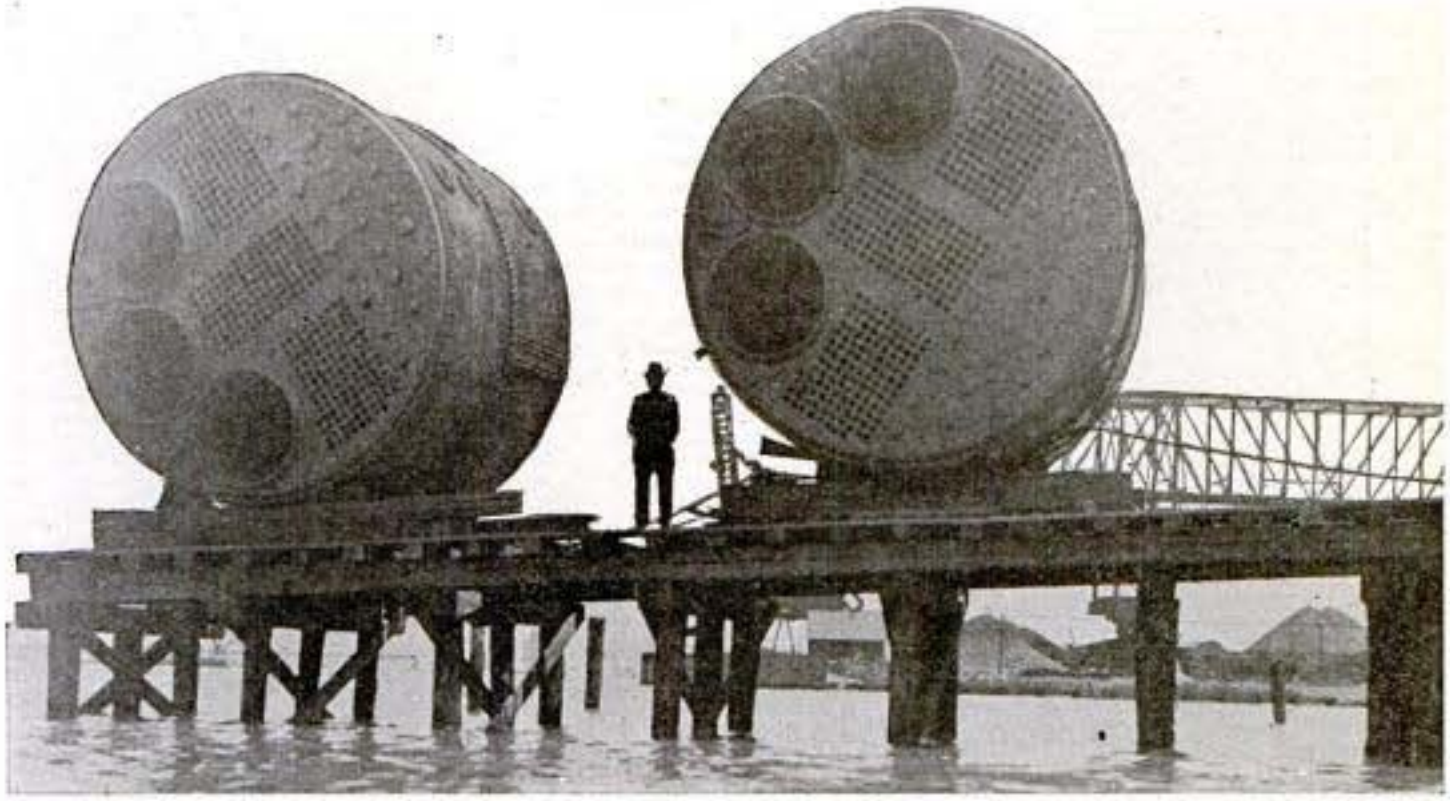
The car is 46 ft. long, 8 ft. wide, and the seats, which will accommodate 50 passengers, are in tiers one above another, hence every seat commands an equally good view. The car is open, with nothing to obstruct the view. At night it is brilliantly illuminated. The conductor acts as guide, pointing out and describing the points of interest. The car has a speed of 40 miles an hour, is driven by four large motors and is equipped with air brakes. The trolley pole is carried by a post at the rear of the car.



**Observation Street Car, Montreal**

# LARGEST MARINE BOILERS EVER BUILT FOR GREAT LAKES

## Special Track Built for Loading them on Vessel for Shipment



Court ry Marine Boiler Works

"The Boilers are Each 15 Ft. in Diameter"

The largest marine boilers ever built for use on the Great Lakes were recently shipped from Toledo, Ohio, to Detroit, Mich., where they will be installed on a new vessel being built there. To facilitate loading the big boilers on the boat for shipment necessitated building a special track out along the pier.

The boilers are each 15 ft. in diameter by 12 ft. long and contain three corrugated furnaces 44 in. interior diameter by 9 ft. 4 in. long and contain 368 three-inch tubes 8 ft. 9 in. long. They have 32 through bolts (2⅞ in.) with nuts inside and outside. The shells of the boilers are 1⅝ in. thick (the heaviest ever put in marine boilers, it is said), and are riveted with 1⅜-in. rivets, driven with 150 tons hydraulic pressure. The tube sheet is ¾ in. thick, the external parts ⅝ in. and the furnaces 23-32 in. thick. The flanges for steam pipe and safety valve are of cast steel; the butt straps are 1 in. thick. The rolling of the steel plates for the shell was a great undertaking and it was necessary to substitute steel gears for the ordinary cast iron gear wheels on the machine.

The boilers were tested to 315 lb. hydrostatic pressure, which gives them a safe working pressure of 210 lb. of steam.

# ENGLISH OPINION OF AMERICAN BOILER INSPECTION

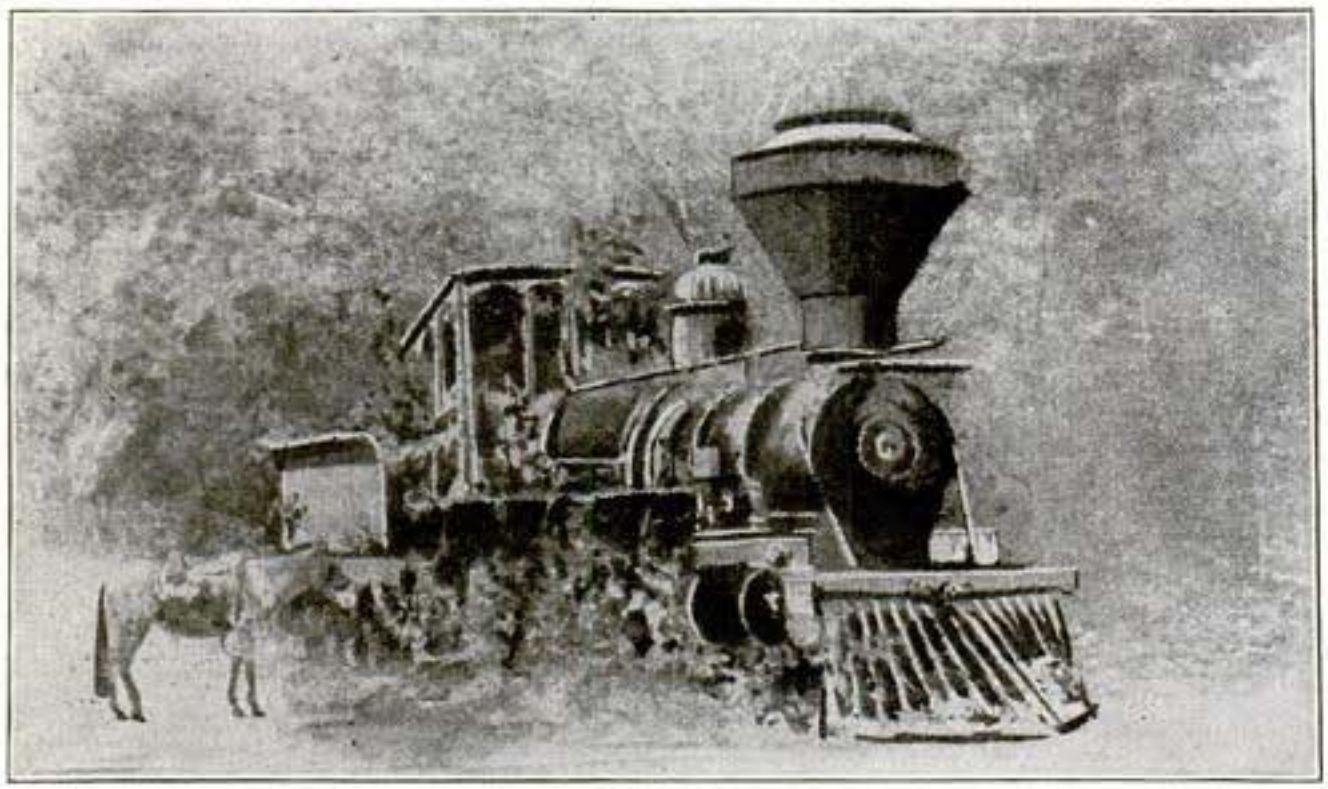
After referring to the widely differing and somewhat conflicting laws of the several states in the matter of boiler inspection, the Electrical Review, London, says:

"In the city of New York the police do the boiler inspection. A few helmeted desperadoes drive up in a van with a force pump, seize an unfortunate boiler, put a trifle more water into it than it will fairly hold, and leave it stretched and weakened with a quite unwarranted certificate that, being reduced in strength by the test put upon it, it is now safe to work until next assault and battery. No one but a born fool would put a boiler to such a casually applied hydraulic test with any expectation of securing safety or proving a fault, though such casual tests do greatly help incipient faults to develop and prove themselves afterwards under steam pressure half that used in the hydraulic test."

Conditions are different in England.

## LOCOMOTIVE LOST IN A JUNGLE

One would naturally think a locomotive was the last thing in the world to be discovered lost and abandoned in a tropical jungle. But such is the fact, and at this moment what was once a fine machine in its day, is rusting away far from the habitation of any human being. It was recently discovered in the woods in Columbia, South America. How it came to be there is a mystery: no tracks lead to its present location; it's a railroad derelict. Tropical vines creep through the spokes of the driving wheels and twine around the throttle lever. Its headlight has vanished, and forsaken and deserted it is a monument to its own death. The Boiler Maker says the name plate shows the engine was built in the United States in 1878.



"How it Came to Be There is a Mystery"

## HOW VARNISH IS MADE

In brief, the making of varnish seems like a simple matter indeed, yet it takes one of experience to obtain always the exact results and a dependable product.

A brass kettle having capacity for 125 lb. of gum and provided with a cover having a hole through which a stirring rod is operated, is filled and put in the fire for the gum to melt, which requires about one-half hour. From 10 to 25 per cent of the gum is lost in the escaping vapors.

In another copper kettle linseed oil is heated in the meantime, and when the gum has cooled a little, the oil, in suitable quantity for the kind of varnish being made, is added gradually to the gum, stirring constantly. The mass is then cooked, the grade and character required in the product determining the degree of heat and the time of boiling. Much cooking makes a dark varnish and less a paler varnish, generally preferred. However a dark varnish made of the best gum, but not darkened by overcooking, wears better than the paler product, says the Master Painter.

A ton of gum must be sorted over to obtain enough light gum for a 125-lb. melting, where light-colored varnish is desired. This makes it very expensive. When the mass has cooled after cooking, it is thinned with turpentine, great precautions against fire being necessary. The varnish is graded according to the amount of oil added to it, which ranges from one to sixty gallons per 100 lb. of gum.

Westrumite, a German product named for a Herr Westrum who invented it, is being tested in this country as a dust eradicator. It is said that a road thoroughly saturated with Westrumite will not require sprinkling for eight or nine days thereafter. The fluid is as cheap as water, and when first tried in Germany, a year ago, consular reports spoke highly of it.

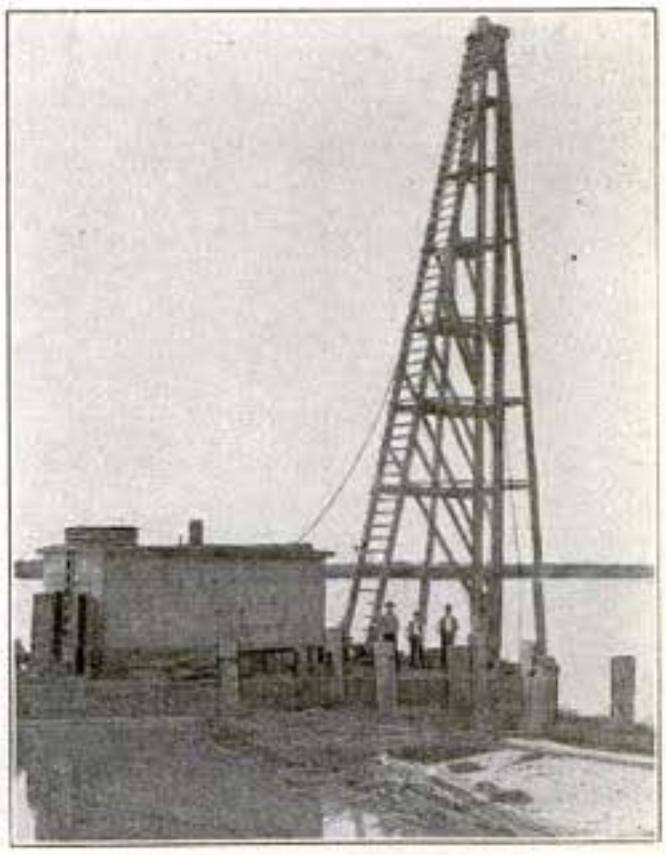
Congress will be asked to change the plans of two new battleships from 16,000 to 18,000-ton ships.

# RECOVERING A SUBMERGED ISLAND

**18 Billion Gallons Pumped from an Area of 7,000 Acres--Average Depth 6 Ft.--Steamboat Furnishes Part of the Power**

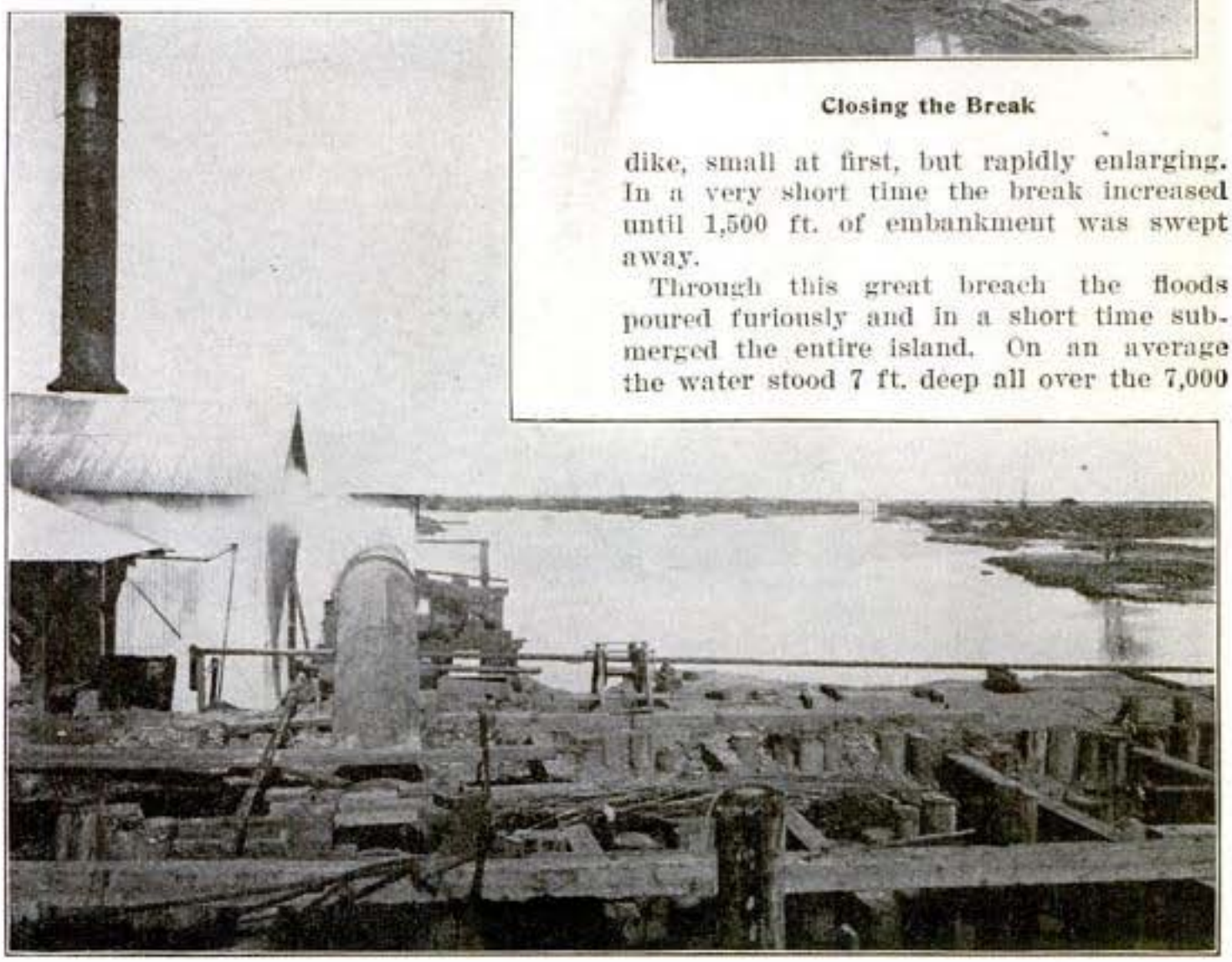
One of the most stupendous pieces of pumping ever undertaken in the United States was very recently accomplished in California. This work was done in San Joaquin county, on Bouldin island. The island in question is formed by the junction of the San Joaquin and Mokolumne rivers, and contains an area of more than 7,000 acres. A large extent of this island is under cultivation, being used for raising asparagus. In fact, this island contains what is undoubtedly the largest asparagus farm in the world.

Bouldin island is of irregular shape, and at a mean stage of water lies about 8 ft. below the level of the streams surrounding it. Many years ago a huge dike was built, following all around the zig-zaggy shoreline of the island, some 30 miles long. During a heavy freshet a break occurred in this dike, small at first, but rapidly enlarging. In a very short time the break increased until 1,500 ft. of embankment was swept away.



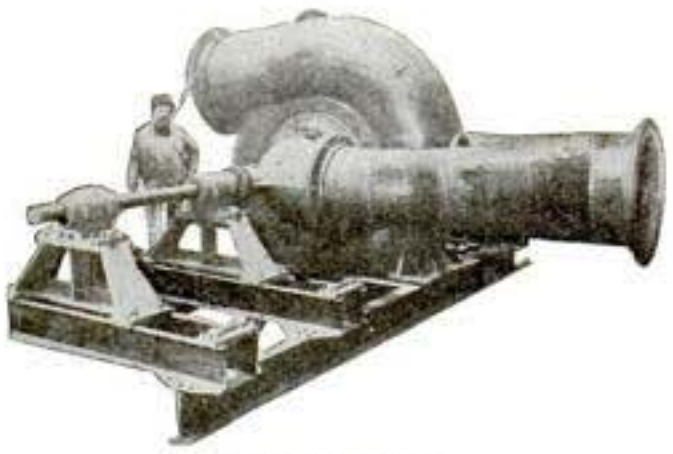
**Closing the Break**

Through this great breach the floods poured furiously and in a short time submerged the entire island. On an average the water stood 7 ft. deep all over the 7,000



**Pumping Plant--Submerged Land Beginning to Appear**

acres. After the subsidence of the floods the first work to do was the repair of the breach. This proved a very difficult and



A 44-in. Pump

expensive task. Finally, after months of work, it was closed up and the inrush of waters shut out. To accomplish this it was necessary to sink the condemned hulk of a sailing vessel 250 ft. long, then piling and vast masses of rock were added. When this heavy work was done, the company owning the island was confronted with the colossal task of pumping out a great lake.

A large pumping plant was installed at the point where the break occurred. The boiler capacity of 1,000 hp. was found to be insufficient, and was supplemented by 500 hp. additional in the steamer "City of Stockton," shown in the illustration. She was made fast to the dike and steam pipe lines with ball joints run ashore from her four 54 in. x 18 ft. boilers.

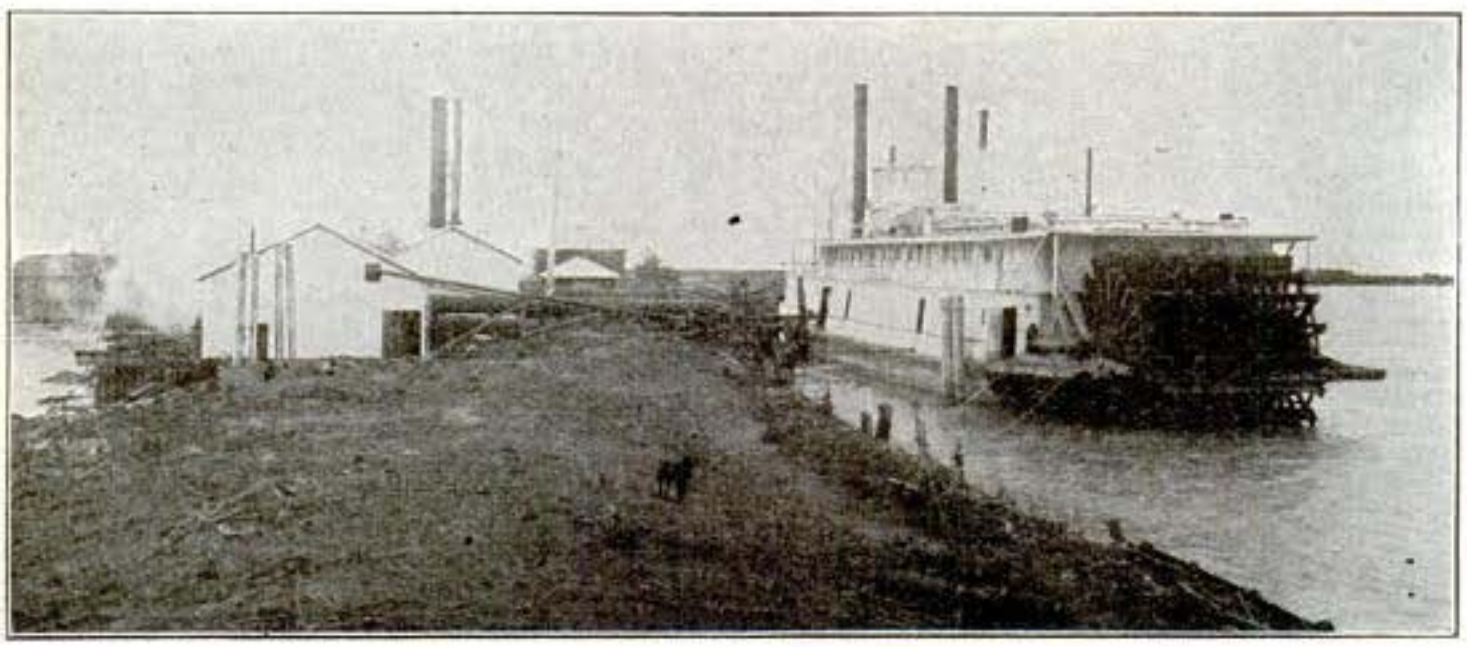
The capacity of the four pumps was 165,000 gal. per min., equivalent to 10,000,000 gal. per hour. During the time of pumping no less than 6 in. of rain fell on the island, which increased the duty to be performed about 1,200,000,000 gal. additional, making the total water pumped 18,200,000,000 gal.

Two 44-in. and two 36-in. centrifugal pumps were installed. The capacity of each of the 44-in. pumps was 60,000 gal. per minute; of the 36-in., 35,000 gal. per minute. These pumps were installed upon the syphon plan, being the first attempt at this class of installation on such large pumps ever attempted upon the coast. The plant was a success in every particular and the water was entirely removed from the island within a period of five months. All four pumps were operated continuously for about 60 days, after which time the pumps operated intermittently, as best served the owners. The oil consumption ranged from 60 to 100 barrels per day of 24 hours, and 2,500 barrels of oil were used in draining the island. Every 24 hours 240,000,000 gallons were thrown out. The pumping was started March 8 of the present year and completed in August.

Now that the pumping is over, it is estimated that the cost of putting the ground again into suitable condition for asparagus will reach another $200,000. It is very probable that the total direct cost of the submergence of Bouldin island will approximate $500,000.

At the present time there are 20,000 sheep on the island and 3,000 Japanese gardeners. A full crop of asparagus is expected next season.

It is said it will require 1,500,000 freight cars, or a train 12,286 miles long, to haul the grain crop to market this year.



Steamboat Supplying 500 Boiler Horsepower

## CAUSE OF "BENNINGTON" ACCIDENT

The naval investigation of the "Bennington" accident finds it was caused by a careless fireman shutting off the steam gauge connection instead of an air cock as he supposed. The boilers were freely fired, but no pressure showed on the gauge. The safety valves stuck. Any 12-year-old boy who has read Popular Mechanics six months should have shown more discretion than the men who blew up the "Bennington."

## STEAMER WRECKS STREET CAR

A peculiar street car accident occurred in Milwaukee not long since when a steamer collided with the north end of a bridge, just as the car was leaving the south end. When the steamer struck the bridge, it tore it open at that end, making a corresponding gap of 35 ft. at the other end, across which hung the street car with its load of terrified passengers. All escaped unhurt, however. Two of the huge bridge spans were wrenched loose and fell on the car. The bridge was damaged considerably and it required several hours to clear away the debris and rescue the car from its precarious position. A scow piled high with railroad ties was backed under the bridge and a cribwork of ties built up to raise that end of the car, which was then hauled off.

## REINFORCED CONCRETE SEWER PIPE

Reinforced concrete sewer pipe can now be made in diameter from 15 in. to 10 ft. Not only that, but they possess a remarkable strength. The illustration, from Municipal Engineering, shows a section 3 ft. in diameter supporting a load of 20,000 lbs., and the pipe 90 days old. Railroads are now using these pipes for waterways under tracks in place of the more expensive iron pipes. Joints are made with iron bands drawn tight, the coupling filled with cement.



**Unusual Accident--Ship Wrecks Street Car**

## NOTABLE WHARF IN MEXICO

A notable example of wharf engineering has been completed after several years construction at Tampico, Mexico. The structure is near the bank near the mouth of the Panuco river, the water being 30 ft. deep on the river side. The construction had to be not only fire proof above the water line, but calculated to resist the equally destructive ravages of the warm salt water below.

The entire wharf is 2,600 ft. long with tracks of the Mexican Central extending the entire length. One-half inch steel cylinders 6 ft. diameter and 55 ft. long, placed about 20 ft. apart, support the wharf. The cylinders were sunk to the sand which is covered by 30 ft. of mud. Creosoted piles of long leaf yellow pine were driven inside the cylinders and the remaining space filled with concrete.

Extensive freight houses were erected on the wharf with electrical machinery for exchanging freight between the cars and ocean-going vessels. The above facts are condensed from a detailed description in the Railway Review.

Courtesy Ry. Review

**Constructing the Piers, Tampico, Mexico**

An International Fire Congress to which fire and insurance men are invited will be held in Milan, Italy, in May, 1906. In Europe as much attention is given to preventing fires, as Americans display in extinguishing them.

The largest public bath in Europe is located at Vienna. It is 587 ft. long, 156 ft. wide and accommodates 1,500 people. It is patronized by thousands of the poor.

## SMALLEST NAVIES IN THE WORLD

Several recognized nations have "navies" which are simply ridiculous. For instance, Panama has one converted yacht; Belgium has one training ship; Peru has a weather-beaten tramp steamer of 600 tons; and Roumania's navy consists of a 1,300-ton cruiser, a small training ship and 8 torpedo boats. In comparison with our "big stick" the above would rate as little more than slivers.

## 1906 STYLE AUTO

Some of the new styles of autos which will be brought out next year will lose much of the accustomed resemblance to a motor car and will easily pass for a horse-drawn vehicle. The running side board is omitted and the rear seat is higher than the other. The room required for machinery is greatly reduced and the lines throughout are much more graceful. The style illustrated will be known as the phaeton auto.

**Phaeton Auto for 1906**

# THE ARMOR-PIERCING POWER OF THE CAPPED PROJECTILE

The strongest, hardest armor plate manufactured today, the product of long years of experiment, study and experience devoted to the question at such steel works as the Krupp, Harvey and Creusot, is not proof against that marvel of penetrative ability—the capped projectile. In 1854 the French sent floating batteries sheathed with 4¾ in. laminated iron to the Black Sea and these were able to resist the fire of the 68-pounders in use at that time; a few years later the "Merrimac," newly clad in iron, sailed out of the Mississippi to uphold the Confederate cause, and to demonstrate the use of the armor-protected war vessel to be practical. Then, indeed, began the competition for supremacy between armor plate and armor-piercing shell, now one, now the other claiming the advantage; striving onward through a period of 40 years unto the present day in which the capped projectile holds the point. Supremacy in this age, however, is as transitory as life, for now, more than than ever before, in a material sense, man is "restrained from no thing that he hath imagined," and the great steel manufacturers are still imagining plates that no shell can pierce.

The cap which is used on the projectile is made of soft steel filled with graphite (though there is a freedom of choice in the matter) is of various shapes and for a 4.7 in. shell weighs about 3.3 lb. The best way to fit it to the projectile is by metallic soldering and with this method, caps can be fitted to old projectiles on hand. Another method, used only with new projectiles, is to screw the cap on the head. Whichever the case, the cap must be securely attached.

Why this mass of material at its head should give to the projectile the extraordinary efficiency that it does is a subject of much theorizing. Certain it is, however, that in tests, a capped ball, moving at a velocity of 2,500 ft. per second, pierced an 8-in. Krupp plate that had successfully resisted an uncapped shell striking it with a velocity of 2,300 ft.; that 15½-in plate was pierced by a 10-in shell with a clean round perforation, only made ragged by flowing metal at its edges; and that other tests beyond number have proved it.

Armour-Piercing Shot (6-in ) After Penetrating Plate

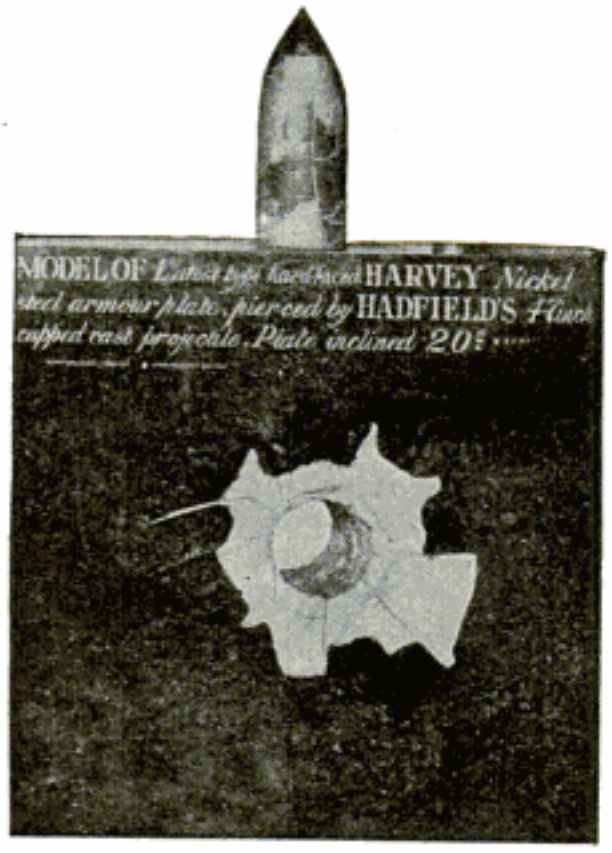

Capped 6-in. Shot


Penetrated 9-in. Plate Twice and was not Injured

Eugen Kodar v. Thurnwerth in an article in the Marine-Artillerie-Ingenieur (translated for the Journal of the United States Artillery by Captain George Blakely) summarizes the noteworthy theories in regard to the action of the capped projectile and refutes a number of them, adducing his own.

Some claim that the cap melts and forms a lubricant for the projectile in its passage through the plate and so reduces the amount of friction resulting. But this could only be true in soft plates where the head and body of the projectile come in sliding contact with the plate, whereas the superiority

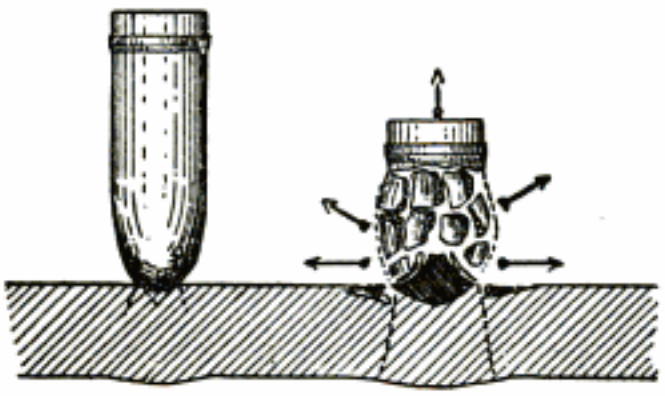
of the capped projectile over the uncapped only obtains in the case of hard plates. Also the amount of energy required to heat and




**Effect of 4.7-in. Capped Cast Projectile on Nickel Steel Plate Inclined 20 Degrees**

melt the cap would decrease the energy available for penetrative purposes.

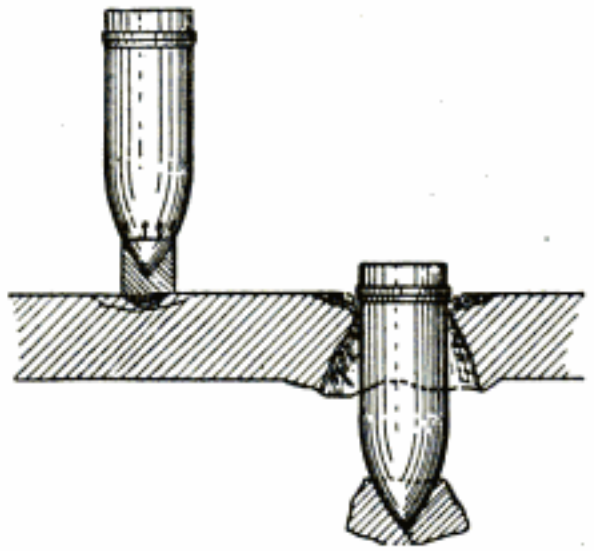
Another theory is that on the impact the cap takes up that amount of energy which would cause the destruction of the projectile and sets free only that part required to penetrate the plate. The cap is neither of sufficient size nor suitable material to take up so large a store of energy without destroying its molecular structure. The cap cannot act as a guide to the projectile, because it has become deformed when the projectile is most in need of guidance, thus another theory comes to naught. The most likely theory, declares Herr Kodar von Thurnwerth is that the uppermost layer of the armor is softened and the plate so transformed into a homogeneous steel plate.



**Action of Uncapped Projectile on Striking Krupp Steel Plate**

In striking the best Krupp cemented and hardened nichel-chrome steel plate a projectile is arrested in motion almost immediately and a pressure of from 220 to 440 lb. occurs on its head. At that instant the head of the projectile is deformed and its then broad rounded surface cannot pierce the plate, but seeks to compress it: this results in the front surface of the plate bulging in, and the rear side bulging out. Meanwhile, the cylindrical body of the projectile moves forward, until, arrested by the deformed head and the plate, the low tenacity of the tempered material is overcome and the projectile breaks up. Its head is broken loose by the resistance and is practically welded to the plate. This is the unsatisfactory effect of the uncapped projectile against hard plate.

The superior action of the capped projectile, it is declared, rests on the fact that, at the first instant of impact with the plate, the head is not deformed. The cap causes the pressure to be distributed over a fairly large cross-section instead of confining it to the point, and so the point pierces the hard



**Action of Capped Projectile on Striking Krupp Steel Plate**

steel like a chisel. The cap has no further work to do; the projectile passes on through the plate alone and uninjured; its point, once entered into the hard steel, forms a path for itself, its head ever-widening, and forces out at the rear of the plate a cylindrical section of the softer material it there encounters. This section breaks up into several pieces. The shell goes through the plate whole, more often than it breaks, and with increased bursting effect from this reason.

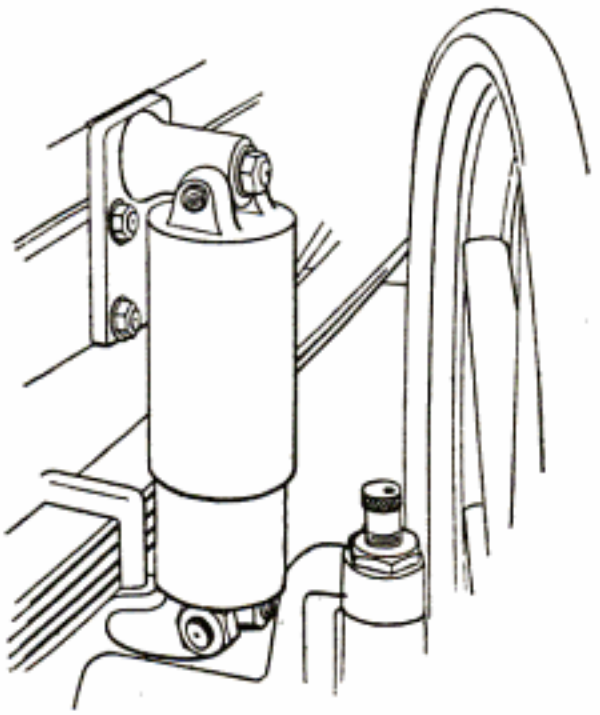
The capped projectile, however has its limitations. Its superiority to the ordinary shell obtains only with hard plates and with high striking velocities; thus at long ranges it is not more effective. The limiting

velocity is stated to be 1,650 ft. sec. This velocity is attained with 4.7 in. forty calibre guns at 2,200 to 2,625 yd. and with modern 9.5-in. guns at 7,650 yd. These are close ranges and leave recourse to longer fighting ranges and increase in thickness of armor plate as the means at present available for protection against the capped projectile.

## AIR CUSHION ABSORBS SHOCK IN AUTO TRAVEL

The question of springs for automobiles is a perplexing one to the manufacturer, as the light, flexible springs which make such comfortable riding at slow speeds on ordinary roads, play so freely on bad roads and at high speeds that bumping on the axles results when the springs are compressed, and often in the rebound the springs break.

A new device intended to absorb the shock of spring play and make the flexible springs practical and comfortable on any road is in



**Shock Absorber Attached to Auto**

the shape of a cylinder in which works an airtight piston. The cylinder is attached to the axle and the piston to the car frame, by means of suitable brackets, while freedom of movement in all directions is secured by universal joints at the points of attachment. A cap or casing on the plunger fits closely over the cylinder and excludes the dust. The cylinder contains sufficient lubricant for 10,000 miles running and on ordinarily uneven roads the air cushion allows the springs to move freely with comfort to the passengers, while at too great speed over rough places the cushion absorbs the shock, sparing the injurious effect on the springs and gradually brings the car to a stop. Wear on machinery is thus greatly reduced, as well as the comfort of the occupants of the vehicle being promoted.

## CLOCK SHOWS TIME IN THIRTEEN CITIES

A clock recently made by an English firm for an eastern potentate has thirteen dials and shows the correct time for as many of

**Clock With Thirteen Dials**

the largest cities of the world, viz: Washington, Yokahoma, Berlin, Teheran, Bombay, Samarkand, Rome, St. Petersburg, London Paris, Vienna, Constantinople and Pekin.

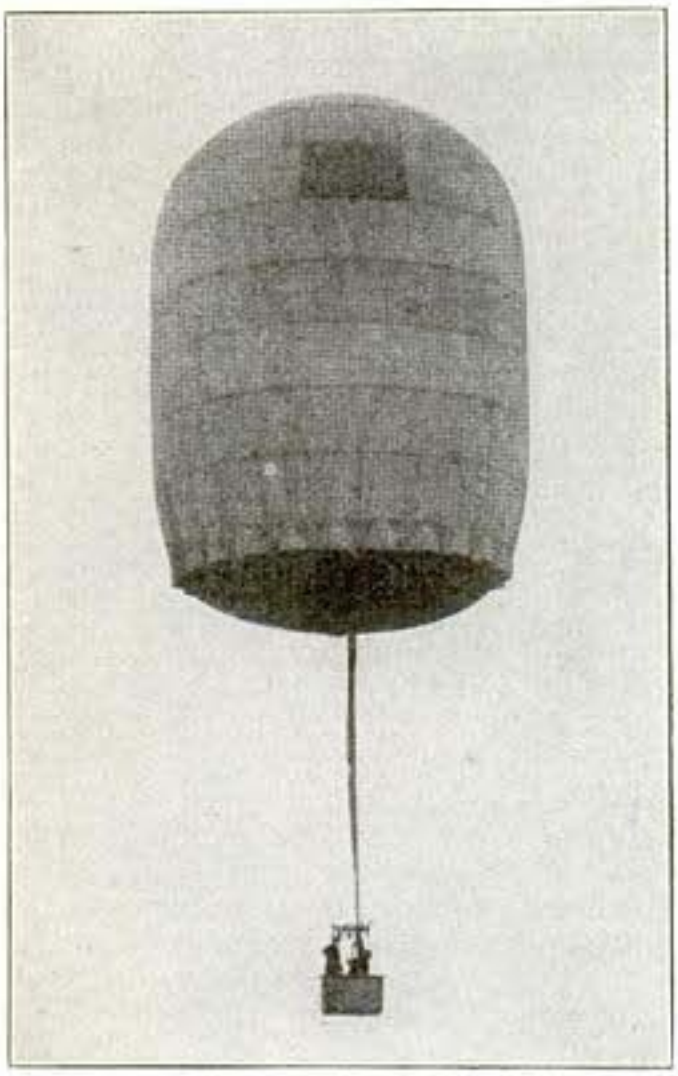
Each dial is mounted in a handsome ormulu frame, richly engraved and bears the name of its city in native characters, as are also the figures. Similar clocks have been made in this country.

## STREET CAR PASSENGERS DRAW PRIZES

In the city of Mexico each passenger who pays fare on a street car is supposed to receive a receipt from the conductor. As the company knows how many receipts are furnished each conductor, it expects a fare turned in for a like number. In order to encourage the passengers to insist upon the receipts, each receipt is made a lottery ticket with a chance to draw one of the 209 cash prizes offered by the company. The prizes range from $1,000 down to a small amount. The scheme has the approval of the authorities and not only increases travel but furnishes an excellent check upon any dishonest employes.

## NEW TYPE BALLOON "SWANSKE"

A new type of balloon has been built by Capt. Unge, a Swede, and named by him the "Swanske." It is a gas inflated vessel of



The "Swanske"

such shape that in case of an accident and a too sudden descent it becomes a parachute.

## HOW TOGO FOOLED THE RUSSIANS

An interesting side light on the battle of the Sea of Japan appears in the Singapore Press in an interview with Capt. Pernitz of the salvage ship "Russ," lost in the battle. The captain was on his way home and said:

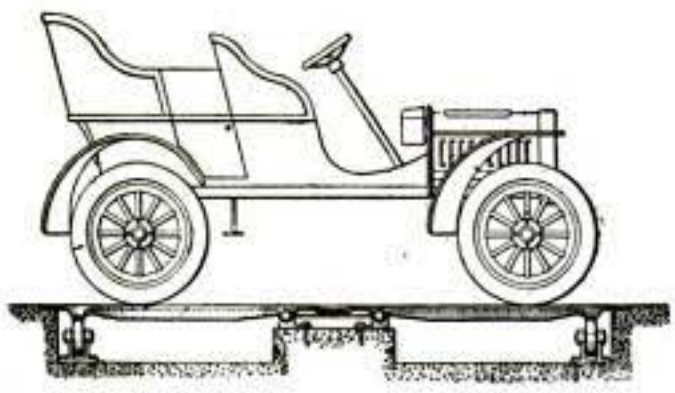
"Engagement?—from the Russian point of view it wasn't worthy of the name. Call it a wild scramble for safety—shelter anywhere. Rojestvensky was taken by surprise, completely surrounded, bewildered. The devilish cunning of the Japanese! They had a huge dummy fleet—wooden ships, marvelous imitations of the real article, guns, fighting-tops and all, lying off the Pescadores. Of this supposed squadron our admiral had information, and passing the Pescadores without hurt, we imagined there was not sufficient weight behind the remainder of Togo's fleet to prevent the greater portion of our armada making for Vladivostok. And then we were trapped, surrounded, and in reality, defeated before the fight began!"

Admiral Rojestvensky, according to the captain, was the only fighting man of any value among the leaders of Russia's forlorn hope. Nebogatoff and the others, by the feeble fight they made of it, were little better than traitors. They were disgraced for ever. Scarcely one of the Russian warships gave battle in the true sense of the word. The whole navy seems to have been dazed by the suddenness of the attack and the overwhelming force of the enemy. There seems to have been no proper understanding between the various commanders as to whether they were all to cut and run, or stand and fight to a finish. Some did the one, a few adopted the latter policy. The result was demoralization, complete, pitiable. Captain Pernitz narrowly escaped with his life.

The marine board at Trieste, Austria, is offering premiums for killing sharks. For specimens of sharks up to 5 ft. long (any species save eatable ones), $2.30 is paid. Larger sharks bring $4.60; very large ones, of two particular species, $11.50; and man-eating sharks bring from $9.20 to $230 premium.

## TURNTABLE FOR AUTOMOBILES

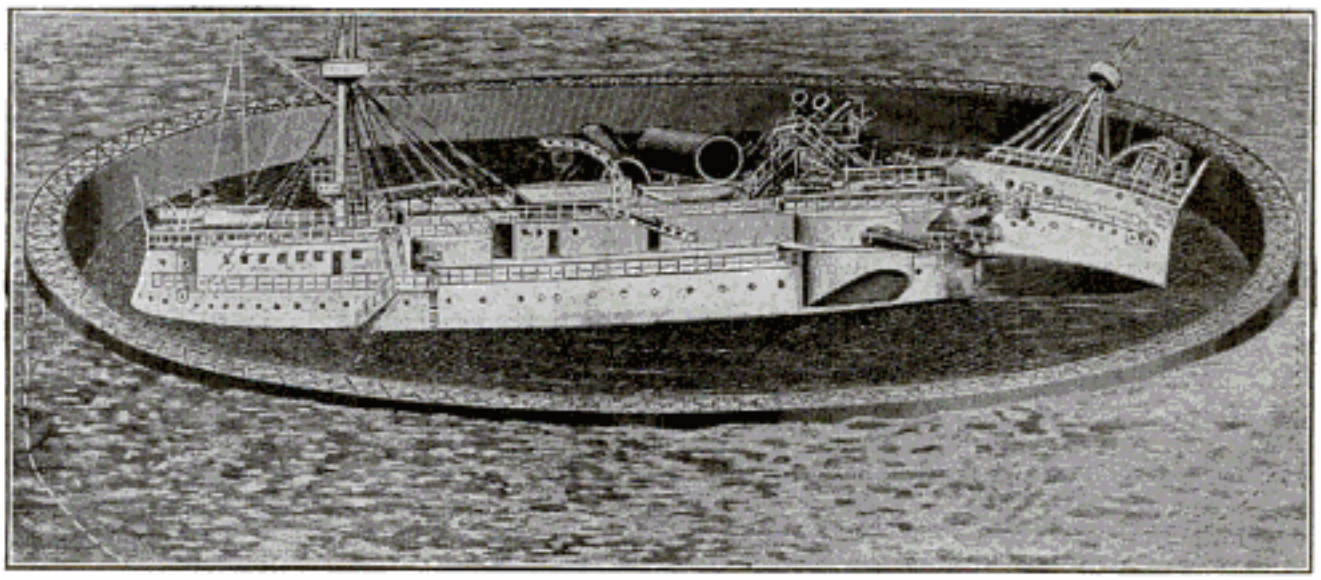
A turntable for automobiles, built somewhat on the plan of a locomotive table, is now available. Where the owner houses his machine in a small shed it is convenient, as



Turntable

it enables him to always run the machine out going ahead instead of backing. For garages, factories and repair shops its advantages are evident.

# MAY RAISE THE MAINE



**Plan Proposed for Raising the Maine**

An effort is again being made to organize a company to raise the Maine, which is an obstruction to navigation in the harbor of Havana. It is now more than seven years since the wreck occurred and during this time the hull with its heavy load has been constantly sinking in the soft muddy bottom of the bay. The only possible way to raise the vessel would be to inclose it in a cofferdam, and pump the water out. Whether it could then be patched and floated would depend upon how badly the hull is shattered.

The proposed dam would be about 400 ft. in diameter and 100 ft. deep. The prospect of recovery grows less each year as the machinery, guns and other valuable salvage is being rapidly corroded in the warm salt water. The authorities claim that the wreck is a menace to navigation.

# CANADA REVIVES GEORGIAN BAY CANAL PROJECT

The Canadian government has revived the old project of a deep-sea ship canal connecting the Georgian bay with the Ottawa and St. Lawrence rivers, thus creating an all-water route from Chicago to the Atlantic and diverting to Canadian channels the mighty stream of commerce that now flows through Buffalo and New York on its way to Europe. Canada would reap an immense profit in tolls.

The annual export of grain from the United States amounts to 2,223,000,000 bushels and of meat 1,000,000,000 pounds, three-fourths of which moves to New York by rail and less than one-fourth from Chicago to Buffalo by boat. The cost of carrying from Buffalo to New York is stated as greater than the cost from New York to Liverpool. The distance from Chicago to Buffalo via the great lakes is 900 miles and from Chicago to Montreal by way of the Michigan, Huron and Georgian bay canal, 905 miles. The Georgian bay canal would undoubtedly afford a cheaper and


**Map Showing Route of New Canal**

shorter road to the foreign market, and though New York would inevitably lose, Chicago and Duluth would gain.

"In all 32 miles of canal with a depth of 20 ft. of water on the sill and 22 in the reaches would have to be built," remarked James J. Hill. The Ottawa river would require some dredging and for the rest, nature has prepared the way. The cost of building the canal would approximate $70,000,000.

## HOW TO MAKE AN ADJUSTABLE SHAVING MIRROR

By C. P. Mitchell

Get about two ft. of ¼-in. brass rod and bend one end in half circle as in Fig. 1. This can be done by holding loosely in the jaws of small vise and bending a little at a time until the half circle is made. The other end should then be screwed tightly in vise and bent up in same plane 1¼ in. from end to a sharp right angle as in Fig. 1.

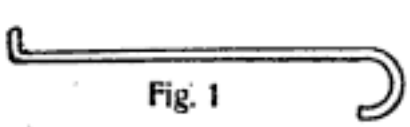


Fig. 1

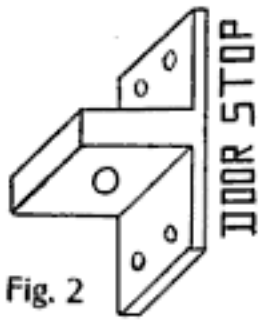



Fig. 2

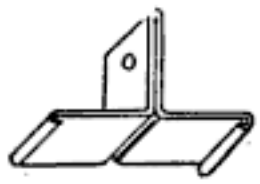


Fig. 3

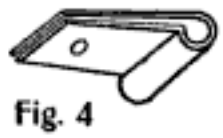


Fig. 4

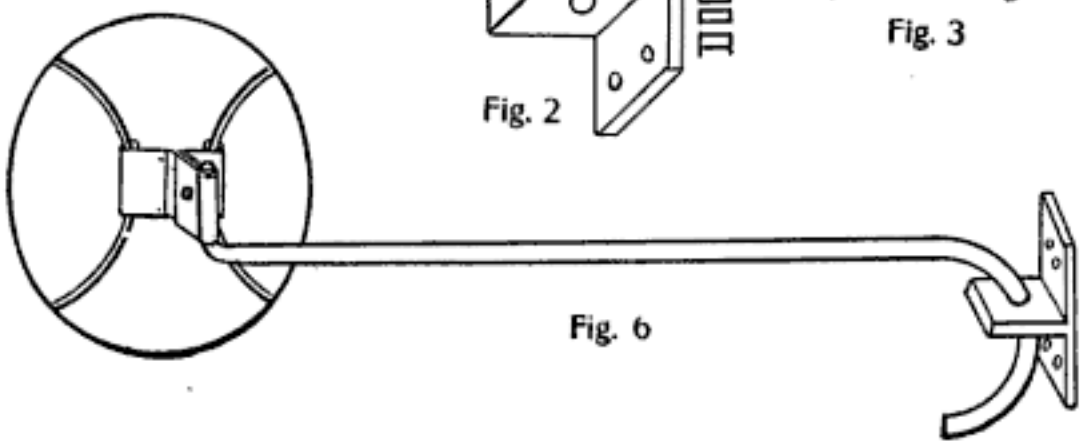


Fig. 6

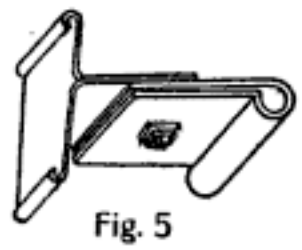


Fig. 5

Get a folding door stop at any hardware store (those used in connection with doors which run on rails) and drill with a ⅜-in. drill, a hole in the middle of the center projection, as in Fig. 2, but when the point of the drill begins to show on the other side be careful to stop when the hole is large enough to admit, easily, the curved end of the ¼-in. rod. In other words, instead of drilling all the way through, stop when the opening is a fraction over ¼ in., making the opening at one end ⅜ in. and at the other ¼ in.

Get about 7 in. of 1-in. wide and 1/32-in. thick brass band and cut with shears in two pieces of 4½ in. and 2½ in. respectively. Bend the 4½-in. piece in half and hammer flat together, then drill a hole for a half inch bolt about ⅜ in. from bend; then place in vise to the depth of 1 in. and bend the two ends apart at right angles as in Fig. 3. The extremities of each end should then be bent around two pieces of stout wire curved away from each other, the ends of which are bent over the edge of a round mirror, as in Fig. 6. If the ends of the wires are pinched together, the mirror can be slipped in and out at will. Now put the 2½-in. piece of brass band in vise to the depth of ¾-in. and bend at right angle; then bend it back over and around end of rod. Now bore a hole near the edge to correspond to the hole in the 4½-in. piece and insert a half inch bolt through both holes as in Fig. 5, using two nuts, one to act as a lock nut.

The door stop can then be screwed to the wood frame of any window (two screws will be sufficient to hold it, using the two upper screw holes). If the curved end of the rod is then inserted and the mirror placed on the other end of rod and the nuts tightened so that it will turn stiffly, it will be found that the mirror can be placed in any position desired and can be put out of the way when not in use. Other door stops can be screwed to other windows in any part of the house and the mirror and rod moved from one to another.

## "POP" WISE AS HIS ANCESTORS

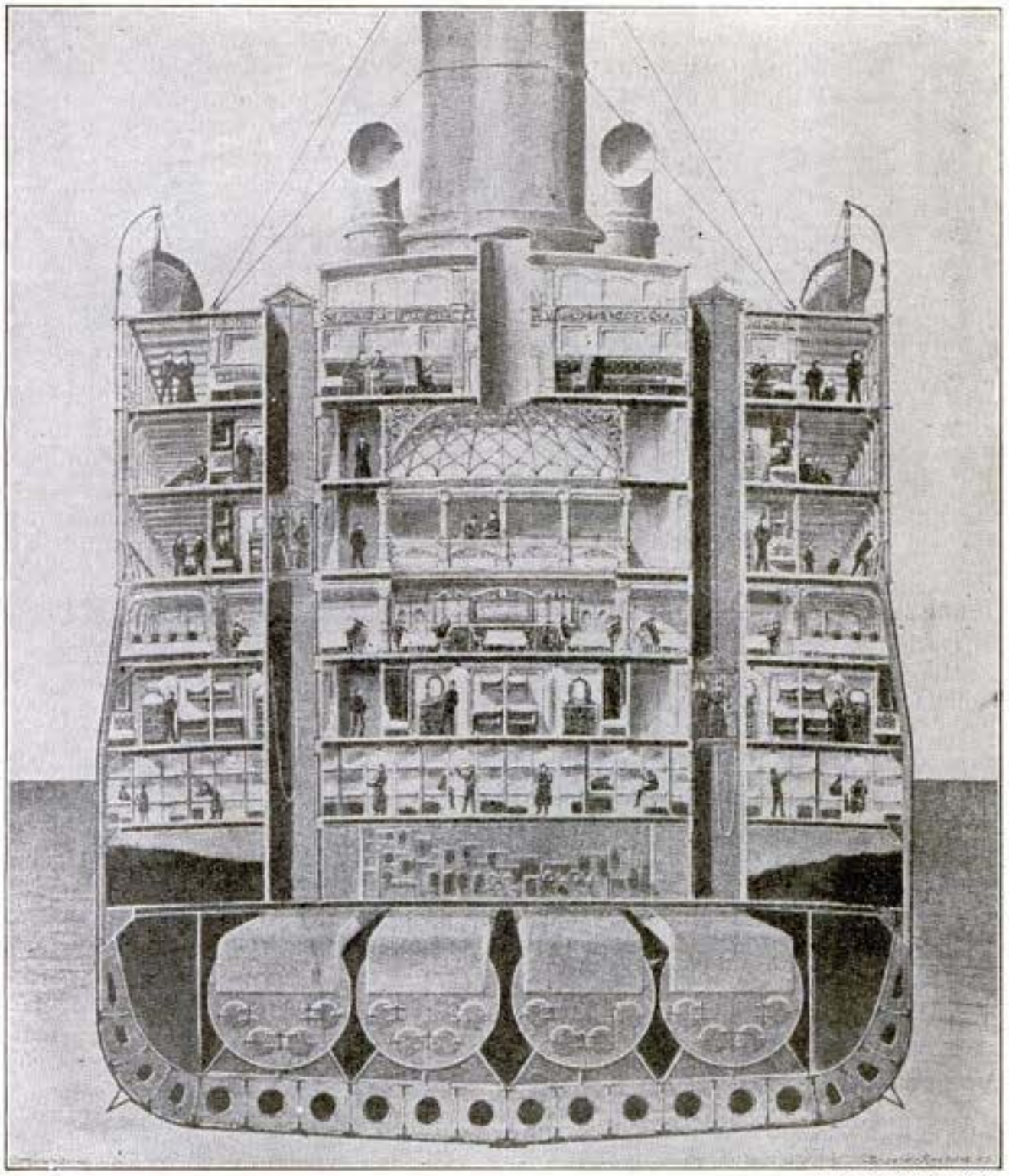
I have been a reader of "Pop" about 6 months, and find it the best mechanical publication I have ever had hands on. I am a marine gaso-engineer and find the Shop Notes a great help. "Pop" may be young, but a Great-Grand-Pop could not be any wiser.—E. S. Stout, San Pedro, Cal.

# TURBINE SHIPS 800 FEET LONG

**Horsepower, 75,000--Displacement, 43,000 Tons--A Floating City**

In whatever respect any big ocean liner in existence has excelled in the past, be it dimensions, capacity, accommodations or speed, the eclipse of her pride is presaged in the construction in England of two monster turbine Cunarders. In such degree will these mammoth vessels surpass all their elder sisters of the deep, competition between them will scarcely be worth while—the twins will have to race with each other to create an interest.

The dimensions of these new vessels are as follows: Length over all, 800 ft.; beam, 88 ft.; depth, 60 ft.; displacement, 43,000 tons. The horsepower of each will be 75,000 and the contract speed is placed at 25 knots. Comparing them with other big steamships of the world, we find that in length the



Courtesy Scientific American.

"Eight-Story" Ship With Elevators

"Baltic" is exceeded by 75 ft. and in displacement 3,000 tons; that the beam of the "Great Eastern," for years the accepted standard for modern steamships, is 5 ft. less than that of the Cunarders, and her depth 2½ ft. less; length, 108 ft. less. And that the speed of the "Deutschland" and the "Kaiser Wilhelm II," for years the fastest ships crossing the Atlantic, is 1.5 knots too slow to keep up with even the contract pace of the Cunarders, which, it is tacitly agreed, will not be their best, as turbine vessels nearly always exceed the contract speed.

The steel plating of the turbine twins is 1½ in. thick, bringing it on the lap to a total of 3 in. on each side. Their extreme draft is 36 ft., but not until the new Ambrose channel into New York harbor is completed will they be able to load to that draft.

The vessels have double bottoms 5 ft. 6 in. in depth between the inner and outer shell. The Scotch boilers are placed four abreast and the large coal bunkers are located in the wings. There are in all eight decks. The third-class passenger accommodations are the best ever afforded; the space is divided into separate state rooms, and the rooms are lighted with port holes. There is a great dining saloon on the upper deck, 80 by 125 ft., and capable of seating over 500 people. In the center will be a large overhead well, extending through two decks, and crowned with a dome of cathedral glass. The first-class state rooms will be 50 per cent larger than the usual size.

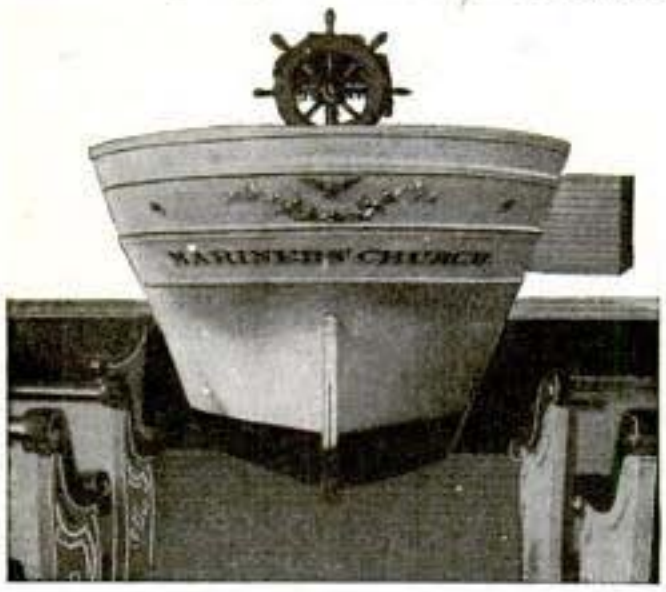
The vessels in height compare well with an eight-story building, and in many respects resemble one. They are equipped with elevators, an innovation that will be greatly appreciated.

Four turbines of a designed indicated horsepower of 18,000 supply the motive power. These will all be placed on the same platform. The stride in size and construction is indeed a long one, but it is hardly to be expected that other large steamship companies will let it rest here—it is merely an impetus to competition.

## UNIQUE MARINE PULPIT

### Where the "Sky Pilot" Preaches From the "Wheel"

What is doubtless the most unique and appropriate pulpit in the world may be seen in the mariner's church, San Francisco. As its name implies, it is devoted exclusively



The Marine Pulpit

to the welfare of the sailors who visit that port from all parts of the world.

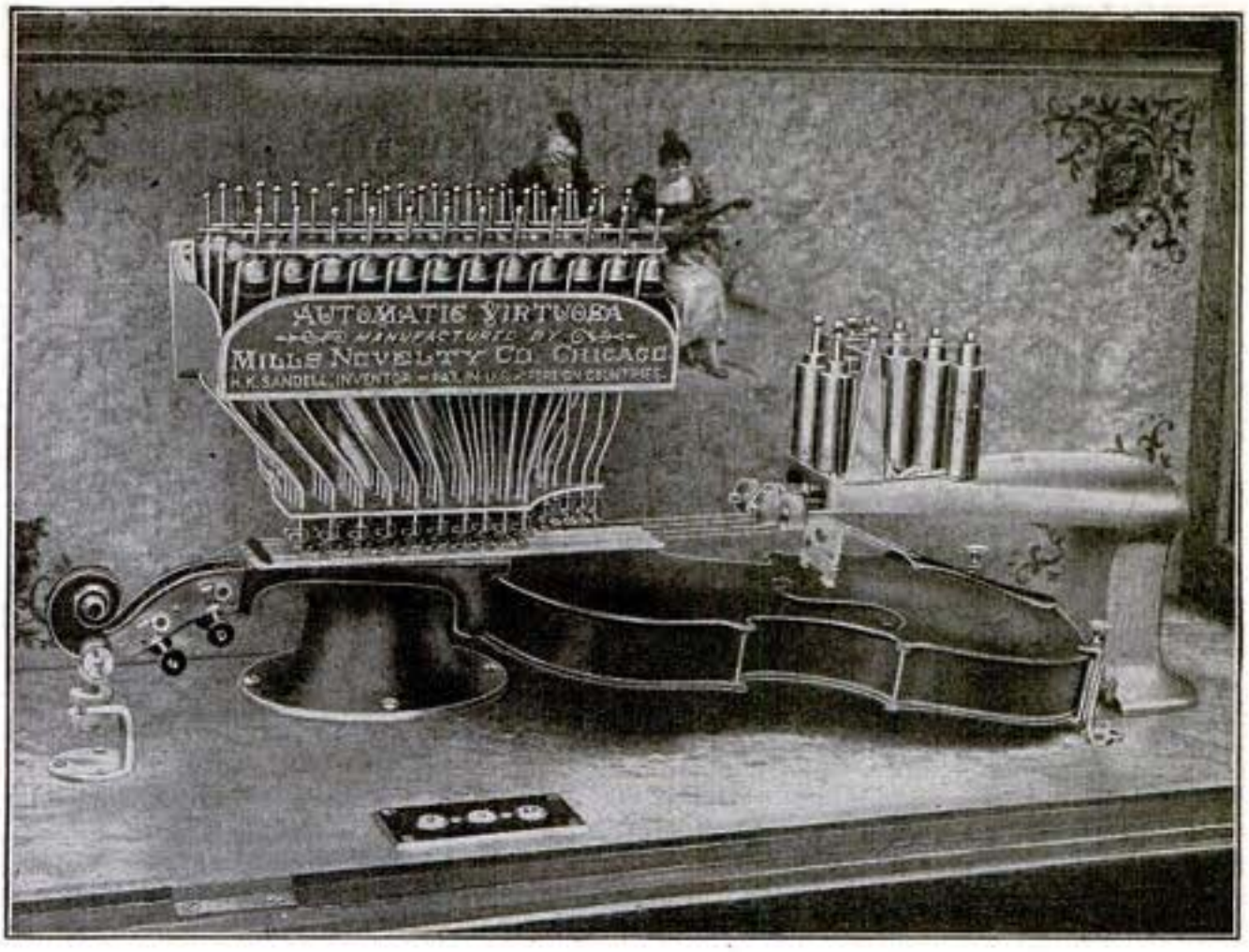
The pulpit platform is in the form of the stern of a ship, modeled after the graceful lines of the "Young America," of San Francisco, a very handsome craft.

## THE ELECTRIC VIOLIN A SUCCESS

### The Most Difficult of All Instruments Now Played By Machinery

All kinds of violin music ranging from the classical production of world-wide artists down to the old time "money musk" of the husking bee, can now be rendered without the touch of a human hand. An ordinary ½ hp. electric motor furnishes the power and other electrical machinery does the rest. While pianos, guitars, cornets, banjos and scores of other instruments have been reduced to mechanical operation, the violin has persistently baffled the hundreds of earnest inventors who have been working for years to perfect a purely automatic mechanical instrument. It is only within the past few weeks that success has been achieved, and a mechanism perfected little short of human in its operation.

The violin itself, which requires no explanation, is firmly anchored on a handsome cabinet. Instead of a bow there are four revolving discs, composed of celluloid and rosin, called sounding brushes,—one for each string. These discs are constantly revolving while the machine is running, and one or more of them press against the strings at the proper moment, by means of electro magnets. At the instant the disc touches its string an electric finger, also




**The Electric Violin**

operated by a magnet, presses the same string at the proper place, just as a musician would do with his own fingers. There are 58 of these electric fingers arranged in rows, as will be seen in the illustration. Connecting with the revolving discs and the electric fingers are wires, not shown, which pass into the lower part of the case containing the violin. These wires each end in a small brass strip, or contact point, which rests upon a perforated strip of paper, which is the score. This paper strip passes over a brass cylinder, and when one of the perforations in the paper reaches a contact point, the perforation allows the brass point to touch the brass cylinder thus completing the electric circuit and operating the proper magnets which control the movements of the discs and fingers. A long perforation therefore produces a long note, and a short perforation a correspondingly short note. The machine can do what no human performer can do, viz., produce a sound on any two or more strings at the same instant, thus securing an orchestral effect.

One would naturally expect a machine could produce nothing but "brassy" or metallic music, but quite the opposite is the fact. The transferring of a piece of music, as actually played by a performer, onto a record from which the perforated strips are made, is a difficult operation, which the inventor guards as a state secret.

The electric virtuoso is designed for use in the home, but will doubtless be first seen on the stage as a musical novelty, and in other places of amusement. It can be adjusted to four times the volume of the hand played instrument, or graduated to suit the faintest, most delicate strains desired. The tuning would naturally seen to be a difficult undertaking, but this is also done mechanically; in fact one who is not himself a musician, can accurately tune the instrument by means of a special roll of the perforated paper, and the use of certain thumb screws. In short, the electric violin is said to be capable of performing any action of the hand-played instrument, and much more.

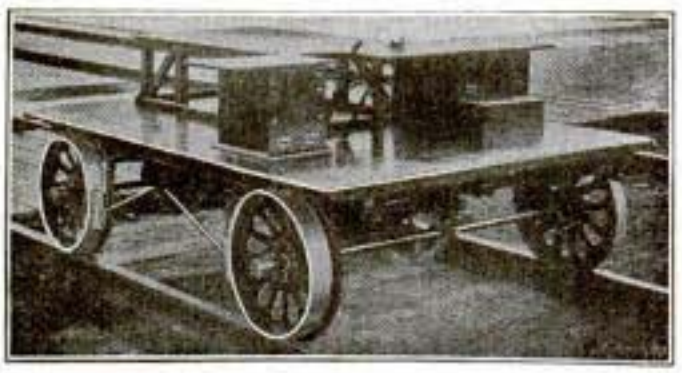
Lightning killed one man and injured two others in a mine 1,008 ft. in the ground in Michigan recently. The bolt struck a cable and ran down into the mine, prematurely setting off two charges of dynamite.

"If explosions occur in the muffler of the gasoline engine, add more battery," advises a contemporary. It may be a case of weak mixture, when the user will have to add more gasoline.—The Gas Engine.

## THE HANDLELESS HAND CAR

From Boston to San Francisco, and as far back as the oldest settler can remember the sight of the section gang pumping their hand car is a familiar one. Thousands upon thousands of these useful but unsightly vehicles travel over 6,000,000 miles each year on the steam railways of this country.

The auto craze seems destined to reach even "Pat," and he is due to ride in ease in the near future when he goes down the line



**"Pat's" Automobile**

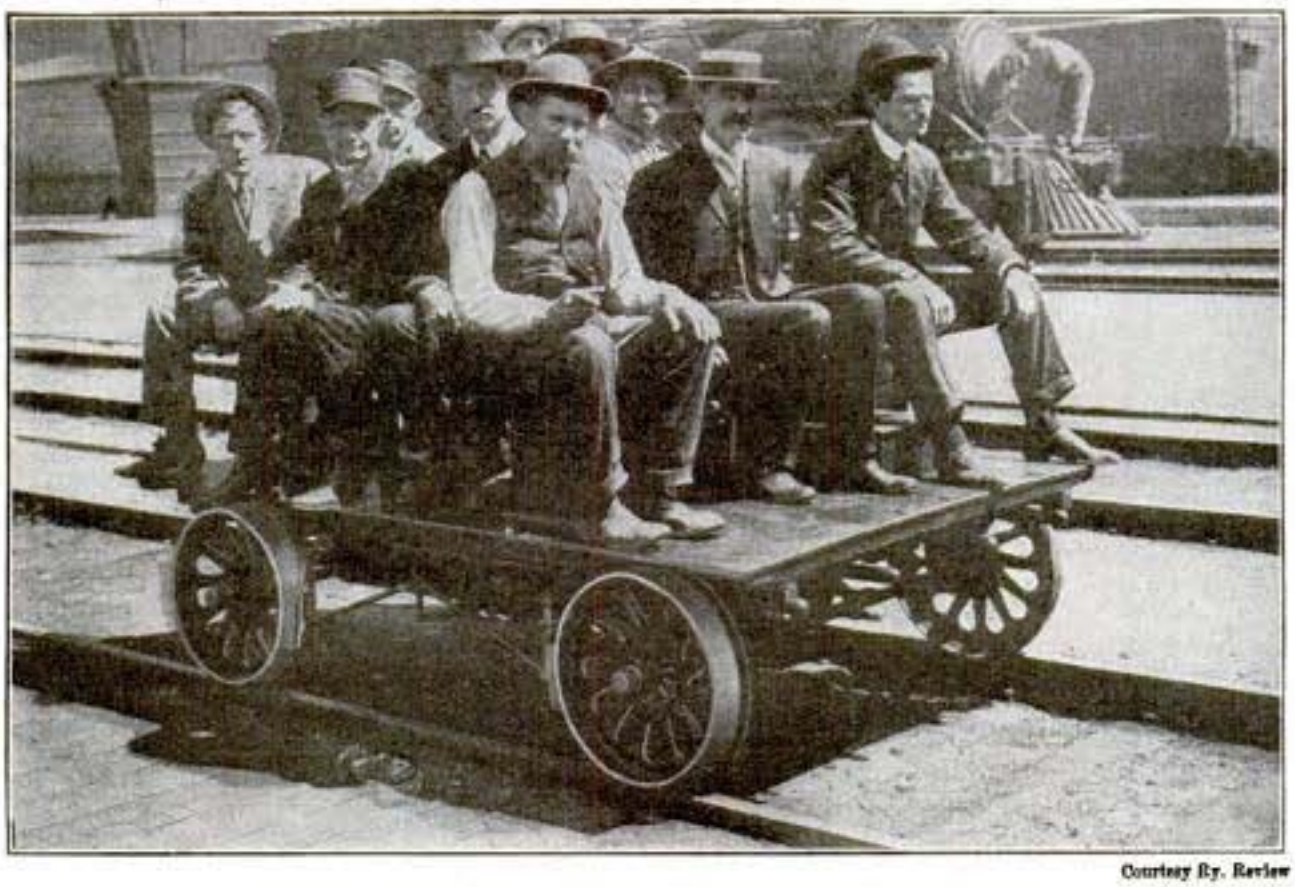
to take out a broken tie or raise a low joint. His auto rejoices in the impressive name of section motor work car, and will carry his crew merrily along at 15 miles an hour, while the boys rest and pack their pipes. The motive power is a two-cylinder, 8 h. p., gasoline engine, with simple gearing and calculated to operate with little experience. The car is made for any guage from 24 in. up, will run in either direction, and is quickly stopped by means of a double hub brake. The framework is of steel tubing, combining necessary strength with minimum weight.

## MUNICIPAL TELEPHONY A FAILURE IN ENGLAND

For years the government has operated the telegraph in England, giving an excellent service at very low charges. Six years ago a bill was passed allowing cities to go into the telephone business. This act was repealed on August 9 last. The plan was a failure. During the six years only 13 cities out of a possible 1,334 took out a license, and of the 13 only 6 put in telephones. On August 9, when the act was repealed, only 5 municipal exchanges were in operation, and all of these were in a sorry plight, financially. In order to protect the public the government has offered to take over and operate the five exchanges, which are situated in Glasgow, Hull, Brighton, Portsmouth and Swansea, and which cost a total of $2,500,000.

The lesson is obvious. Something more than a merely honest administration is required, for there is no suspicion of the grafting prevailing in this country, in connection with the failure.

Just try to imagine the Czar taking chances on a trip in a submarine!



Courtesy Ry. Review

**Motor "Hand Car"--Carries 15 Men 15 Miles an Hour**

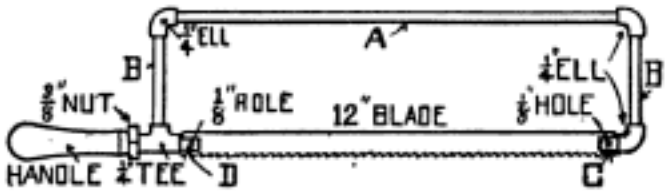
All the articles appearing in this department are reprinted in book form at the end of each year.

# SHOP NOTES

Contributions to this department are invited. If you have worked out a good idea or know of one, please send it in.

## A PIPE HACKSAW FRAME

To make this frame, three ¼-in. ells, two pieces of ¼-in. pipe, 3 in. long (B B), one piece of ¼-in. pipe, 15 in. long (A), and one




**Pipe Hacksaw Frame**

¼-in. tee will be required. C is a piece of bolt iron, pipe-threaded and screwed into the ell; D is a piece of the same metal, 4 in. long, which is bolt-threaded and passed through the reamed tee with about 4 in. of thread on the handle side of which is a nut by which the tension of the blade may be adjusted. Parts C and D both have slits sawed in them parallel with the blade, into which the blades are fastened by means of pins passing through holes drilled for the purpose. Fittings without bosses on them make a neater appearance, and all brass pipe for the frame looks better, also.—Contributed by Apprentice.

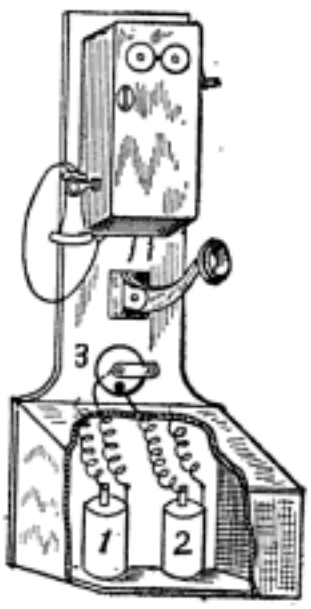
## HOME-MADE WATER HEATER

A water heater to have steam and drip connection hitched into steam heating system, the same as a radiator, water entering lower tee and being discharged from the upper tee, is shown in the illustration.

The heater may be used either vertical or horizontal, though it should be pitched toward the drip end, and may be used with or without tank. It consists of outer pipe or shell, through the center of which passes smaller pipe for steam, the water being around this smaller pipe; heads or bushings in the end make the shell watertight where the steam pipe enters with a long thread at both ends.

A 1½-in. outside pipe with tees 1½ in. x ½ in. or equivalent; with bushings 1½ in. x ¾ in. for the end and bushings ¾ in. x ½ in. for connecting and making watertight joints with ½ in. steam pipe at the ends, will heat a volume of water 6 or 8 ft. long.—Contributed by W. J. Barber, North Adams, Mass.

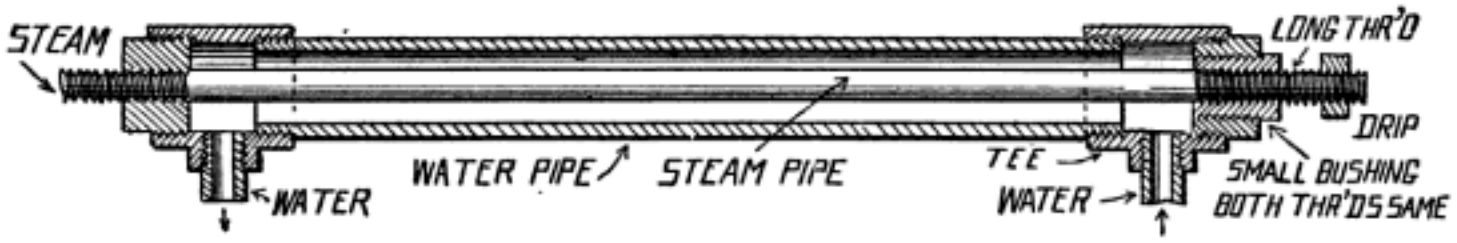
## BATTERY ECONOMIZER FOR TELEPHONES




By the use of a switch (3) placed on the telephone box or on the wall and wired up with the batteries (1 and 2) as shown in the diagram, a great deal of wear on the batteries can be saved and they will last a long while. — Contributed by Geo. R. Bowers, Shelbyville, Mo.

## VARNISH PRECEPTS

One coat of varnish never cracks.
Two coats of varnish seldom crack.
Three coats of varnish often crack.
Four coats of varnish always crack.
—Master Painter.




**Home-Made Water Heater**

Shop Notes for 1905 contains 200 pages; 385 illustrations. Price, 50 cents. Write for a copy to-day.

## DRAWING FIVE-POINTED STARS

One of the easiest methods of making a five-pointed star by the use of the steel square is to describe a circle of a given diameter, then divide up the circumference by indicating chords equal to seven-twelfths of the diameter. The five points where the chords intersect the circumference will be the points of the star, says the Metal Worker.

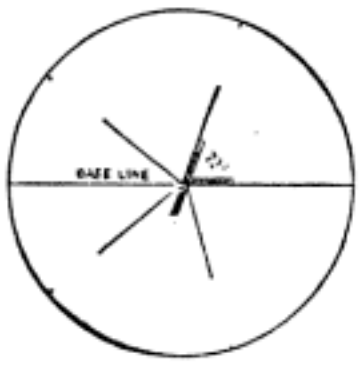


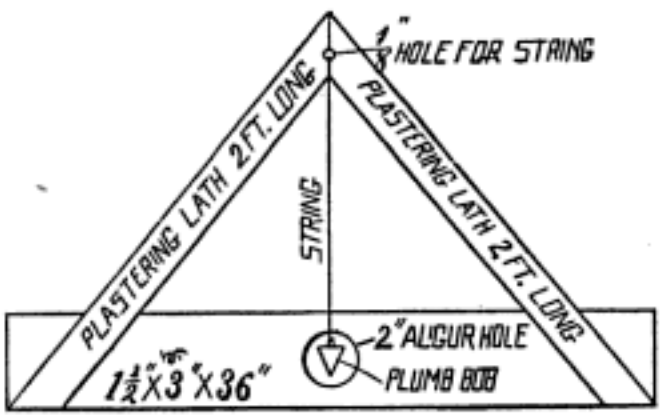

Fig. 1.

Fig. 2.

Another good way is to divide 360 by the number of points the star is to have, which will give the distance between points in degrees. Then get the angle on the bevel square with the protractor, and using any diameter as the base line, the points may soon be obtained. This operation is illustrated in Fig. 1, while Fig. 2 shows the star with points joined.

## HOME-MADE LEVEL

A home-made level which suffices for all ordinary purposes is shown in the diagram. The level is made of a 1½ in. x 3 in. x 36 in. piece of wood, two plastering laths,



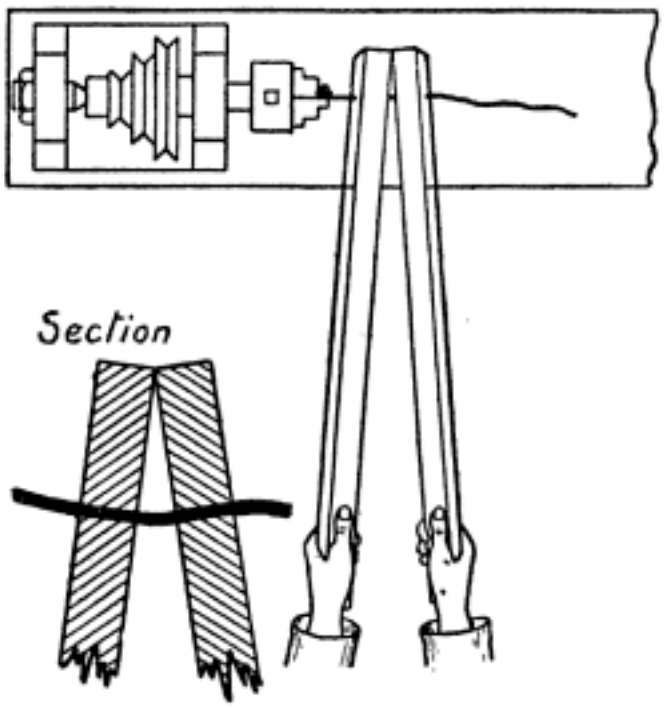

**Home-Made Level**

2 ft. long, a string and a plumb bob. The illustration explains the construction. The lathes may be nailed to the bottom piece with shingle nails.—Contributed by Jas. Morton, Jr., Dunn, Tenn.

## STRAIGHTENING WIRE IN THE LATHE

Short lengths of thick wire are very hard to straighten with the mallet, but the work can be done in the lathe, quickly and easily, says the Model Engineer, London.

Grip the wire in the chuck, and roughly straighten it with the hand, so that it clears the bed. Now get two pieces of hardwood about 1 ft. by 2 in. by ½ in., and bore a hole in each about 2 in. from one end to fit the wire. Slip them on the wire close up to chuck, and start the lathe. Grip the pieces of wood in the position shown in the sketch, keeping the ends farthest away pressed close together and twisting the pieces of wood in opposite directions. Move slowly along the wire, keeping in the same position. If necessary, repeat the operation. New holes




**Straightening Wire**

can be bored in the wood at a short distance from the old ones when these become too large.

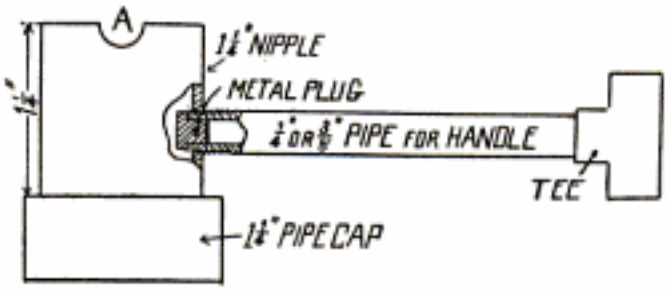
## WATERPROOF ELECTRIC LIGHT SOCKETS

Electric lights so located that they are exposed to water may be made waterproof by the following described means:

Before putting the lamp into the socket fill the receptacle with a lump of soft putty, then screw the lamp in. This will force the putty into every crevice and make it absolutely tight. Unscrew the lamp again, clean the putty from the threads so that it will not stick there as it hardens, then screw up again. A correspondent of Power says this works exceedingly well.

## BABBITTING LADLE MADE OF PIPE

Into a 1¼-in. pipe cap screw a 1¼ x 1¼ in. nipple, threaded on one end only. On the inside of the nipple file a mouth or lip (A) for pouring a small stream. Make a handle of 1¼-in. or ⅜-in. pipe of whatever length is

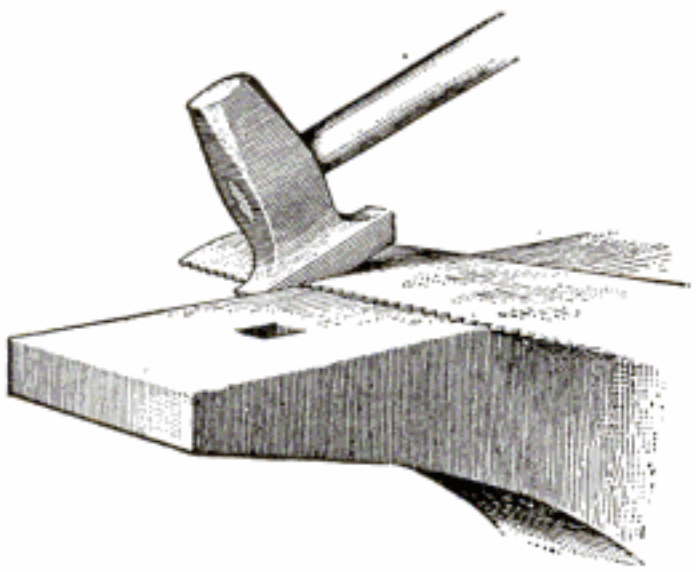



**Babbitting Ladle**

most convenient for your use. Screw the handle into the nipple about ¼ in. to brace it and plug it at that end with a pipe plug, or an old bolt threaded in. On the other end of the handle screw a tee, making it convenient to hold. Have all the threads neat and tight, so the ladle will not be unsightly.—Contributed by Apprentice.

## TO CUT THIN STEEL WITHOUT TEMPERING

A simple method of cutting a thin piece of steel as from a saw blade, without drawing the temper, is shown in the illustration.



**Cutting Thin Steel**

A correspondent of the Blacksmith and Wheelwright recommends this method.

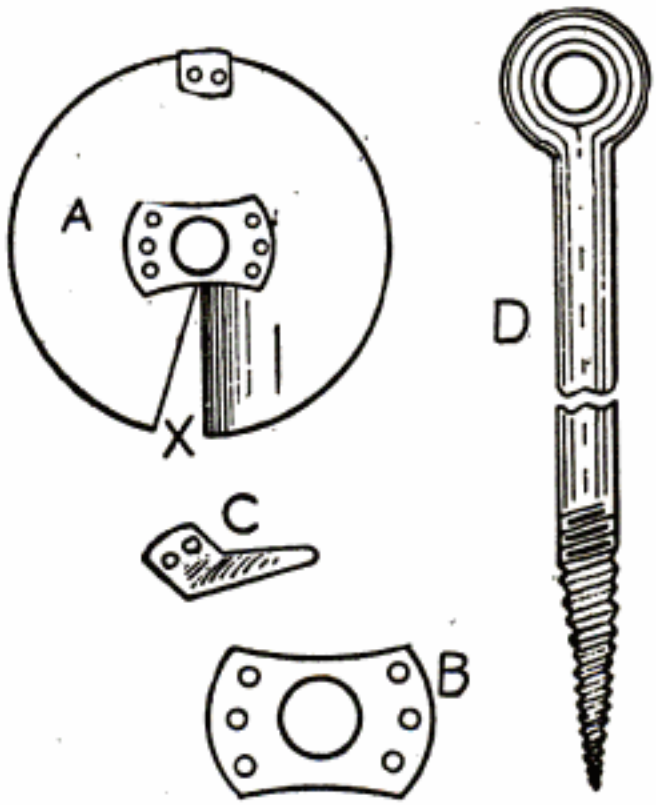
## CLEANING SMOKED CEILINGS

A smoke-blackened ceiling may be cleaned by coating with a mixture of starch and water, allowing this to dry, and then brushing off lightly with a soft brush.

## HOME-MADE POST AUGER

Any circular disk that is wide enough and not too thick—as, for instance, the broken blade of a disk harrow or a circular saw blade—may be used for the auger blade. Center punch the plate, mark the size required with a compass and cut in circular shape.

At the center of the disk punch or drill a ¾-in. hole, then split the disk from the center to the outer edge and cut out a small strip as at X in the sketch, so as to leave a better opening, says the American Blacksmith. Sharpen both sides of this split and turn one down and the other slightly upward. Forge a piece like B and rivet it on the blade as at A. Forge a lip, C, from a




**Home-Made Post Auger**

piece of spring steel and rivet it to the blade on the edge opposite the split part. This lip is intended to cut the soil on the outside, while at the split the cutting is directly down into the soil. The whole blade should be concaved on the outside edges—turned upwards.

Make the stem D, of ¾-in. round iron, 4 ft. in length, with an eye for a cross handle and with its point extending 6 in. below the blade and twisted like a twist drill. Cut a thread on the stem and screw into plate B.

This auger is particularly useful in boring holes in stiff clay soil. It makes a clean hole and can be used without water. The boring can be fast or slow, according to the downward bend given the cutting lip of the disk.

## CHEMICAL FORMULA TABLE FOR PAINTERS

The painter who has some knowledge of chemistry will find it greatly to his advantage in the preparation of his colors. For those who cannot take such a course the following table compiled by the Master Painter will be found useful and worth memorizing.

| Common Name | Chemical Name. | Formula |
|---|---|---|
| Barytes, Blanc Fixe, | Sulphate of Barium, | $BaSo_4$ |
| Gypsum, Terra Alba, Plaster of Paris, | Sulphate of Calcium, | $CaSO_4 2H_2O$ |
| De-Hydrated Plaster of Paris, | Sulphate of Calcium, | $CaSO_4 2H_2O$ |
| Whiting, Lime Carbonate, Lime, Paris White, Spanish White, English White, Marble Dust, | Carbonate of Calcium, | $CaCo_3$ |
| Sublimed Lead, "White Lead," | Sulphate of Lead, | $PbSO_4$ |
| White Lead, Corroded Lead, | Basic Carbonate of Lead, | $2PbCO_3PbH_2O$ |
| Silex, Silver White, Infusorial Earth, Wood Filler, Ground Quartz, | Silica, | $SiO_2$ |
| Zinc White, Zinc Oxide, | Oxide of Zinc, | $ZnO$ |
| China Clay, Clay, | Hydrated Silicate of Alumina, | $2SiO_2A1_2O2H_2O$ |
| Litharge, Lead Oxide, Massicot, | Lead Monoxide, | $PbO$ |
| Red Lead, Orange Red, | Lead Oxide, | $Pb_3O_4$ |
| Chinese Vermilion and Mercury Vermilion, | Sulphide of Mercury, | $HgS$ |
| Venetian Red, Indian Reds, Mineral Brown, Etc. | Oxide of Iron, | $Fe_2O_3$ |
| Chrome Yellows, M and L, | Chromate of Lead, | $PbCrO_4 + PbSO_4$ |
| Chrome Yellow, O, | Chromate of Lead, | $PbCrO_4$ |
| Lamp and Gas Black, | Carbon, | C |
| Ivory, Bone, and Drop Black, | Carbon, etc., | C. |
| Graphite, | Graphite, | C |

## THAWING FROZEN GROUND WITH LIME

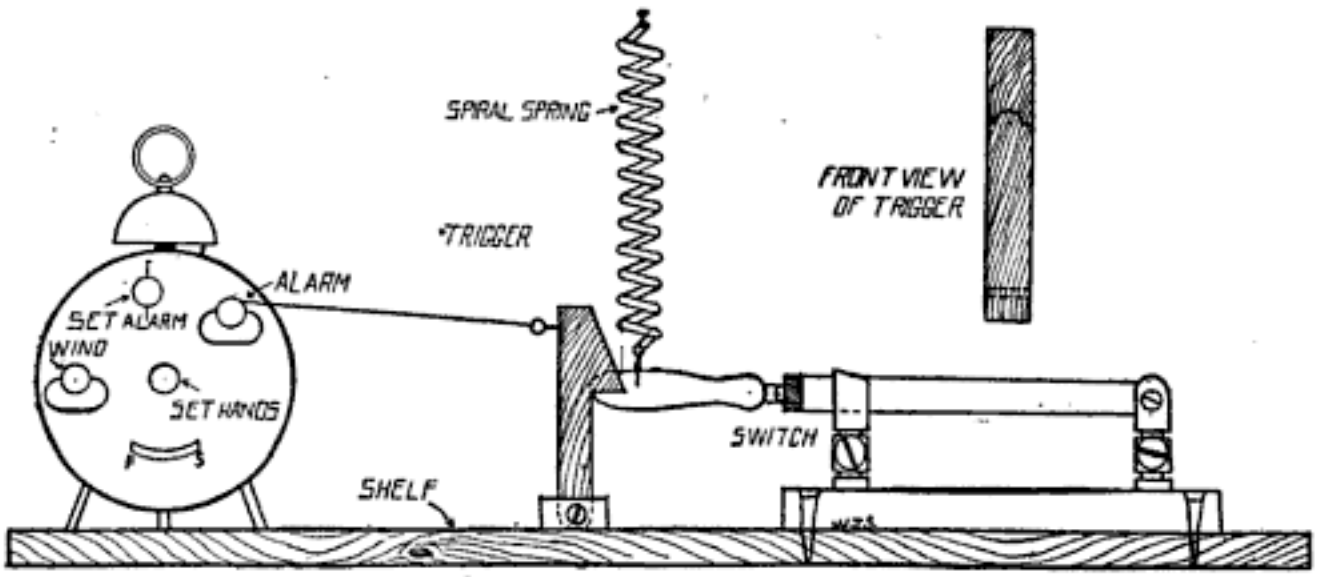
Lime may be successfully used in thawing frozen ground where excavating must be done to gain access to frozen pipes. Apply one barrel over night, covering well, for thawing out frost 1 ft. deep, in a trench 2 ft. wide and 8 ft. long. Hot water may be used with the lime to good advantage.

## AUTOMATIC CUT-OFF FOR ELECTRIC LIGHTS

Fasten an alarm clock on a shelf, and about 10 in. away place a switch. Make a trigger as shown in the sketch and mount it on an axle, so it will move backward and forward. At a point on the wall above this arrangement, fasten a spiral spring at such a height that when the switch is closed and then let go, it will stretch the spring. Fasten the spring to the switch with a screw eye.

Attach a stout cord to the alarm key of the clock and run the cord to the trigger. Put a hook on the string, so that it may be hooked to the trigger, showing that the alarm is wound up. Wind and set the alarm; pull the switch down and put the handle in the trigger, then fasten the string on the trigger.

When the alarm goes off, the key will




**Automatic Cut-Off for Electric Lights**

wind up the string, thus pulling the trigger out and releasing the switch handle, which is pulled up by the spring and so cuts out the lights. This device is convenient for store keepers who wish to keep lights burning in show windows until a late hour.—Contributed by W. J. Slattery, Emsworth, Pennsylvania.

## TO MAKE A STEAM GAUGE ALARM

A steam gauge alarm that will sound whenever the steam pressure falls to a predetermined point is described by a correspondent of the National Engineer.

Connect up an ordinary annunciator bell with the gauge, running one wire to the post of the pointer and the other to a piece of copper fastened to the face of the dial, but insulated from it. The wire to the gauge pointer will make contact with the piece of copper on the dial face whenever the steam pressure drops to the predetermined point, thus closing the circuit and ringing the bell. The alarm may be thrown out of service at any time by a switch placed in the circuit.

## HOW TO PAINT IRON, ZINC AND GALVANIZED IRON

The best time for painting new iron is at the foundry as soon after casting, or being wrought or rolled, as possible, says the Master Painter. Paint it when a dry wind or warm sun will act upon it; do not paint it in the early morning or damp evening. First see that the iron is thoroughly dry and free from rust, and then coat with red lead and linseed oil, a thin coat, just enough to penetrate the pores of the iron. The first coat must dry hard. Follow up with three other coats containing red or white lead in as great proportion as possible.

To paint old iron, burn off all rust and scale, brush with turpentine or paraffin and proceed precisely as with new iron.

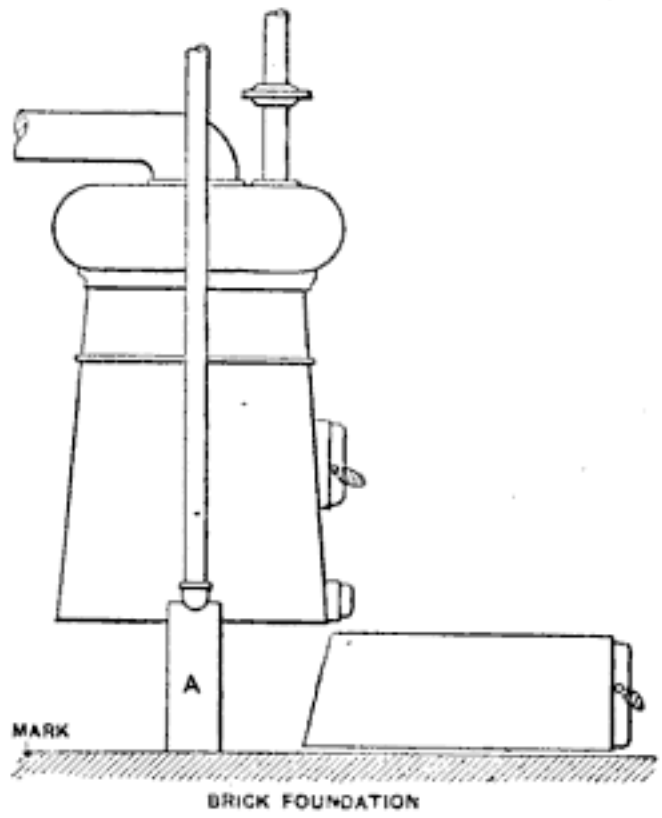
For zinc, the first coat should consist of white lead, red lead and turpentine, tempered with varnish. Wash new rolled sheet zinc with a solution of a tablespoonful of hydrochloric or nitric acid to a gallon of water, or scratch the surface with No. 2 glasspaper before painting.

Treat galvanized iron the same as zinc, but do not use the acid preparation, nor scratch. Very smooth, bright tin plate must be first dulled or scratched and the first coat should be oilless.

## PUTTING A NEW BASE UNDER A BOILER

In substituting a new base under a boiler for a broken one, a correspondent of the Metal Worker tells how the job can be done quickly and without disturbing any of the connections.

Saw out two hardwood wedges and drive them under the two return pipes in position as shown at A in the sketch. These should be of proper height to lift the boiler off the base just far enough to allow the broken base and grates to be slipped out and the new base slipped in. Brace the boiler from the walls to keep it from slipping




**Putting a New Base Under a Boiler**

sideways, and before removing the old base score a deep mark with a cold chisel on the brick foundation, so that the new one may be put in on exactly the same spot.

## HOW TO MAKE CELLULOID INCOMBUSTIBLE

Make an ether-alcohol solution of celluloid and an ether-alcohol solution of ferric perchloride, then mix the two solutions. This will give a clear, syruplike liquid, yellow in color and yielding no precipitates. Pour it into a suitable vessel and leave for spontaneous evaporation. A shell-colored substance will be produced, which after washing and drying, gives the result desired, says the Model Engineer, London.

Celluloid so treated will be pliant, transparent, uninflammable and incombustible.

## SLED [illegible] MOVING LAWN SPRINKLER

In watering a lawn in the old-fashioned way one has to do much walking in moving the sprinkler from place to place, shutting off the water and turning it on again, and is certain to get his feet wet in the operation. To avoid all this trouble, make a little sled of 1x4 in. pine, 24 in. long, with ½-in. board nailed across the runners, which should be about 20 in. apart.


**Sled for Moving Lawn Sprinkler**

Then fasten the sprinkler on the sled, well toward the front, attach about 8 ft. of rope to the sled to draw it by, and arrange the hose so it will run out back of the sled to prevent its tipping over. The sprinkler can then be moved to any point on the lawn without one's running back and forth through the wet grass to turn the water on and off.—Contributed by J. S. Wallace, San Jose, Cal.

## RACK FOR KITCHEN UTENSIL COVERS

Tin covers for stew pans and kettles are a nuisance when not in use, as they are apt to slip off the shelf, if piled upon it, and are sure to get out of order so that one must search for one of the right size. To make a convenient rack for these covers get some strips of ½-in. boards, half of them 1 in. wide and the other half 3 in. wide and all as long as the shelf is wide. Have as many of each width strips as you have covers, or more. Fasten these strips with shingle nails to the bottom of a shelf that is about 5 ft. from the floor as shown in the sketch. The strips should be fastened at various distances apart in order to accommodate the several sizes of covers. Place the covers with knobs or handles downward.—Contributed by J. S. Wallace, San Jose, Cal.


**Rack for Kettle Covers**

## EASY METHOD OF BURNING 50 BUSHELS OF CHARCOAL

In our February number instructions for burning 100 bushels of charcoal were given; the accompanying directions are for a smaller quantity—say, forty or fifty bushels.

Pick out a spot where rocks are not too plentiful and where perpendicular walls of ground will not crumble too easily and dig a hole 6 ft. long, 4 ft. wide and 6 ft. deep. Cut into lengths of about 4 ft. 7 in. enough of sound dry wood to fill the hole. Pile the wood alongside the hole where it will be within easy reach. Get an armful of dry kindling, split lengthwise, and a couple of armfuls of green evergreen brush or green hay (wet gunny sacks will do as well).

Put the kindling at the bottom of the hole and set it on fire; next pile in the wood on top of it, packing it close together. For the first 2 ft. work rapidly. Proceed with the filling until the hole is full and round it up a little, making it highest in the center. Then lay on the covering material—green grass, wet sacks or whatever it may be. Spread this material along the center, leaving a 6-in. space at the edges of the pit uncovered, then throw dirt on the covered portion. The 6-in. space left is for ventilation and escape of smoke.

The pit will not require much tending. When the flames break through, close it a little at that place, but not more than is necessary. By starting the burning at six o'clock in the morning, the material will be burned to coal by nine o'clock in the evening—fifteen hours. Along in the afternoon the fire will be getting pretty well to the top. Tramp on the pit, and if any holes in it can be felt, remove the covering at those places and trample in some short pieces of wood about a foot long until the hole is filled up even with the top, then replace the covering. Toward the last it must be watched closely, as the flames are apt to break out.

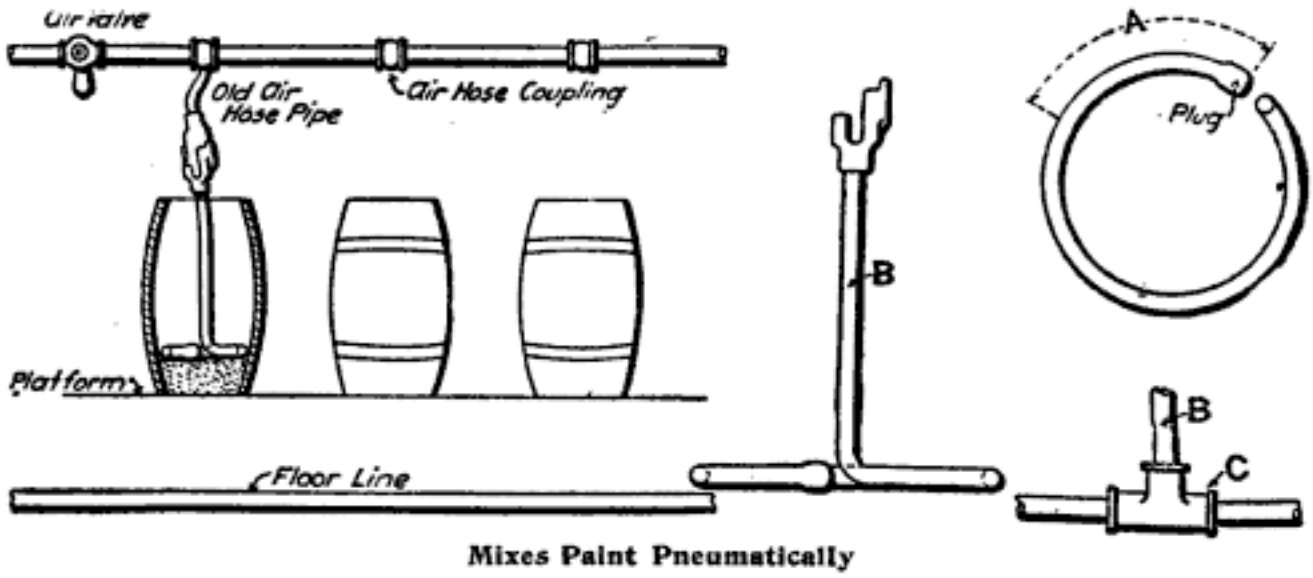
If for fifteen hours a thick cloud of smoke has rolled above the pit, at the end of that period it should be burned to coal. Put damp covering over the 6-in. marginal space, pile on dirt to a depth of 8 or 10 in., wet it and trample down till solid. In the morning wet the dirt again, thoroughly. In two days the coal may be dug out.

Choose a still day without wind for burning; foggy or rainy weather will not affect the burning.—Contributed by John H. Evans, Dewey, Montana.

## HOW TO MAKE A PNEUMATIC PAINT MIXER

A pneumatic paint mixer may be made of ½-in. iron pipe, with an air hose coupling attached to the upper end and the lower portion of the pipe bent into a circle slightly smaller in diameter than the inside of the bottom of the barrel. In the circular portion, drill a number of $\frac{1}{16}$-in. holes spaced 2-in. centers. Air escaping through these holes, agitates the paint in the barrel and mixes it thoroughly. The end of the pipe in the circular portion may be merely plugged up, but is apt to clog in the section indicated at A, because the force of the air expends itself before this point is reached. Probably a better way would be to connect B to the ring by a T, as shown at C, so that the air will circulate from both directions, says the Canadian Machine Shop.

The mixer may be connected to an old air hose and this, in turn, connected to the main line with an air hose coupling.




**Mixes Paint Pneumatically**

Contributions to our Shop Notes department are invited. Brief, clear descriptions and rough sketches are acceptable.

Life subscription to Popular Mechanics, $10; five years, $3.

## ACID-PROOF INK FOR ZINC

An acid-proof ink which may be used with a drawing pen on zinc, says the Draftsman, consists of 1 dram verdigris, 1 dram sal-ammoniac powder and ½ dram lampblack mixed with 10 drams of water.

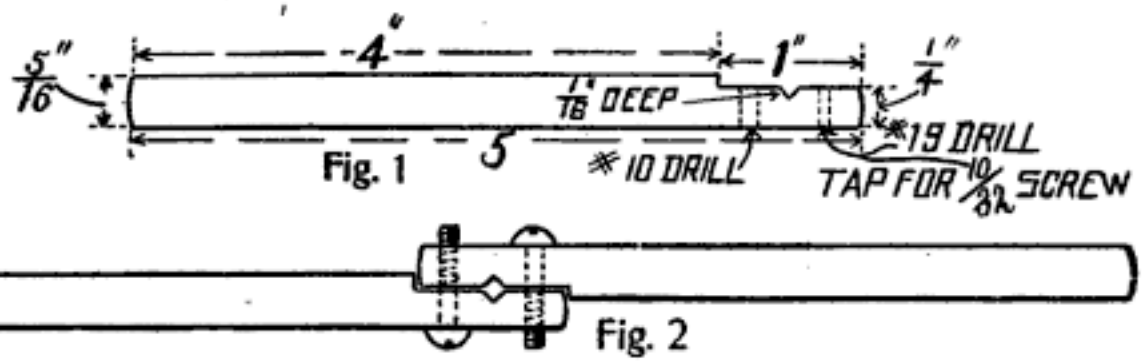
## MENDING PORCELAIN AND GRANITE WARE

Porcelain and granite ware, which cannot be soldered, may be mended satisfactorily in the following way:

Mix together litharge and glycerine to about the consistency of putty and then apply to part to be mended. Apply it at each side of the hole and press it through, then finish off smooth and let dry. When dry it will be as hard as the porcelain and will withstand any heat that porcelain will.—Contributed by W. C. Telford, Santa Barbara, Cal.

## SIMPLE TAP WRENCH

A simple tap wrench is made of $\frac{5}{16}$-in. steel rod in two parts each 4 in. long. One end of each part is treated as shown in Fig. 1. Fig. 2 shows the two parts joined to form the wrench.—Contributed by M. Frank Jordan, 45 Jackson Pl., Chicago.

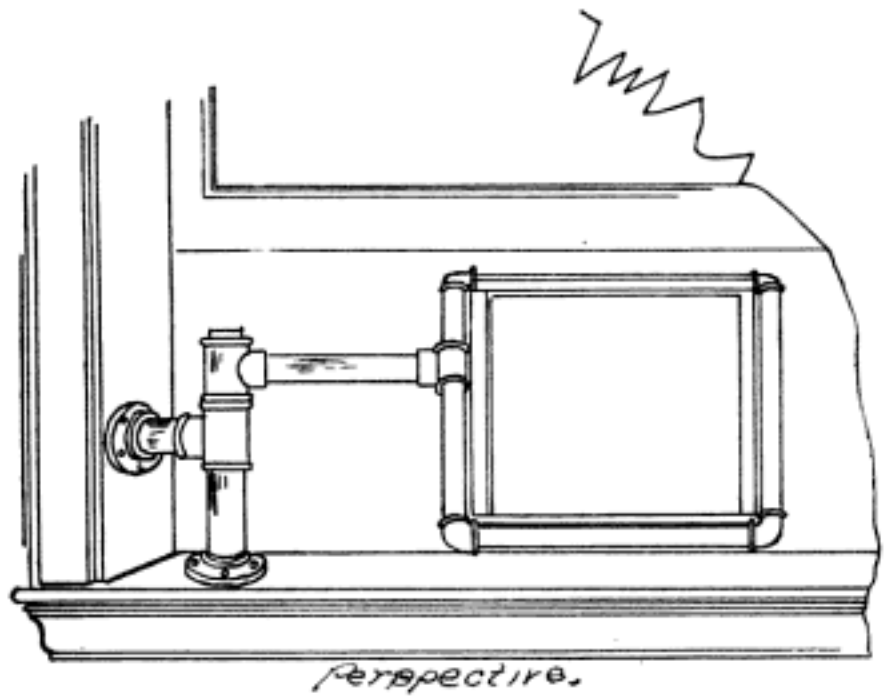


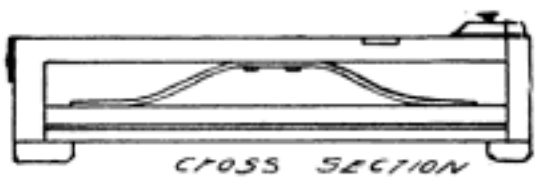

**Handy Tap Wrench**

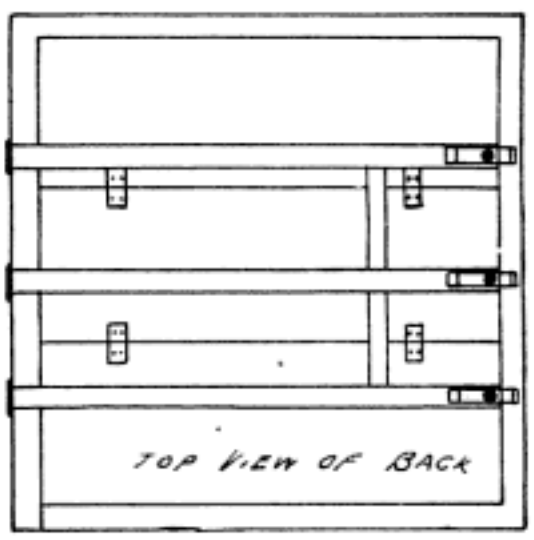
## HOME-MADE BLUEPRINT FRAME

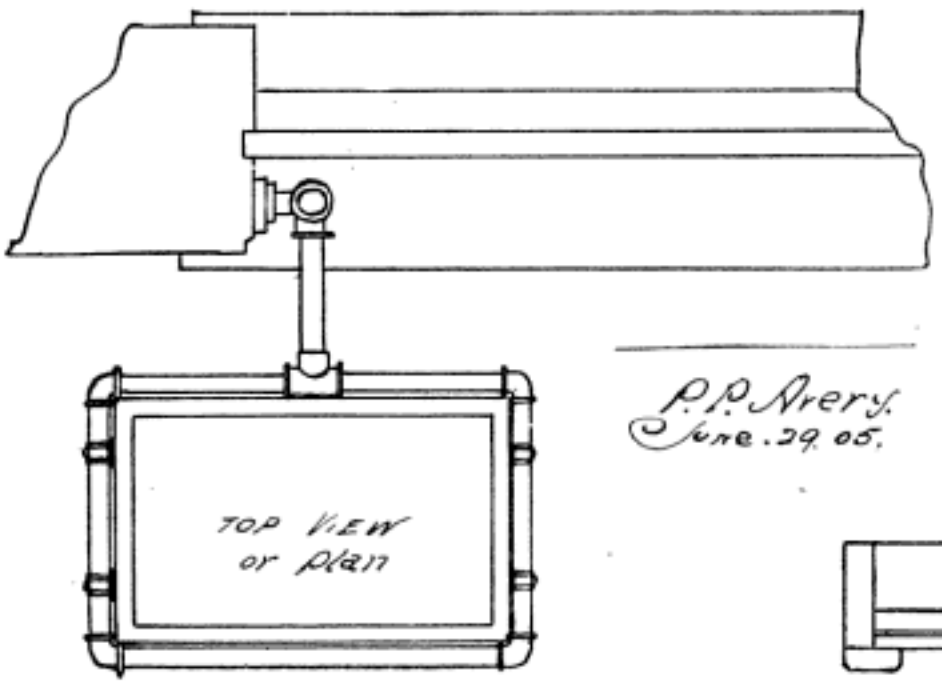
The frame itself is made of pine wood, bound on the corners with iron corner bands. The sides should be at least 1¼ in. thick by 3 in. wide, and the front piece which is planted on the edges of the sides, should be 1¾ in. by 1¼ in. and screwed on very securely; they must lap over about ½ in. on the inside of the frame to make a rest for the glass. The back should be made in three pieces, held together by hinges, and should be ⅝ in. to ⅞ in. in thickness, according to the size of the frame.

In the building of this frame, the most time should be given to the spring levers, which must be accurate and have close contact. The levers are hinged to the side and are pressed down on the back, forcing the back of the frame tightly against the glass by the three brass springs and being held in place when down by three cupboard door snap locks. The three levers should be held together and in line by the iron or wood brace across their backs, this brace is very essential and should be securely attached. A thick piece of felt should always be laid on top of the paper so that the back may bear evenly on the print and make close contact between the blueprint paper and the tracings, which fact is absolutely necessary. The iron frame as shown, is ordinary black iron pipe, ½. in to ¾ in., according to size of frame, and the stand, which is fastened to the window trim, is heavier weight, 1½ in. to 1¾ in. The collar must fit snugly around the nipple, and a drop of oil once in a while is necessary. After the iron frame

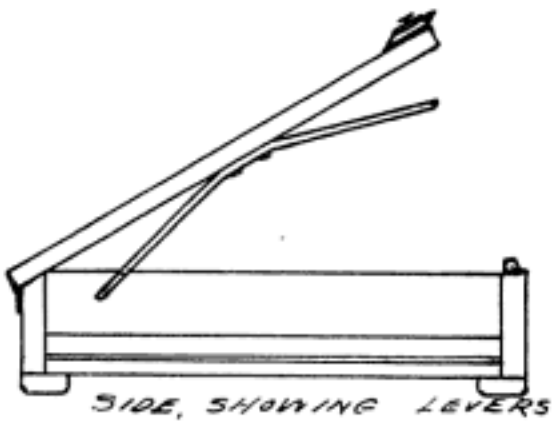


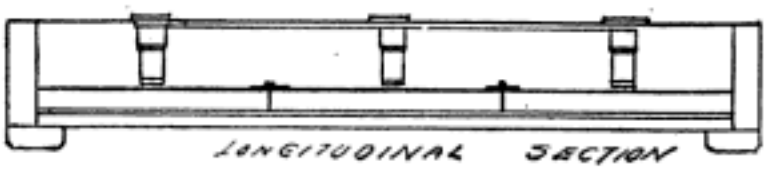




P. P. Avery.
June. 29. 05.




**Home-Made Blueprint Frame**

is built, it is a good plan to set-screw the connection between the frame and arm, as this joint would have a tendency to drop down on the treads. The frame can then be revolved on the arm treads, to put in the drawings and then turned glass side up and swung out the window to print. I have made and set up one of these frames in our drafting room, and it has given universal satisfaction.—Contributed by Prentice P. Avery, 39 Woodside Av., Ridgewood, N. J.

## PRESS STOPPING DEVICE

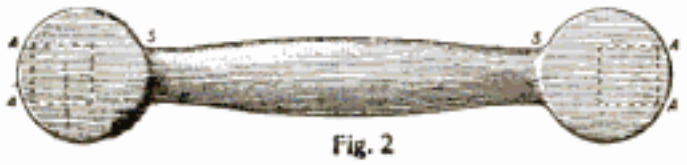
The accompanying illustration shows an arrangement installed by W. Schafer of San Francisco, Cal., on a press used for baling dry goods, to stop the press in case of a careless packer letting it run up too far. As the movable platform rises, weight B, which is a little heavier than weight A on the other side, is pushed up and so lowers weight A (securely fastened to the cord so that it cannot move along it) and the lowering of weight A throws the circuit breaker, C. In case the man making a bale should neglect to stop the press when his bale is made, the circuit breaker will throw in the usual manner, so that it is not necessary to have any arrangement for stopping on the descent. The pulleys must be good ones and so arranged that the cord, when loose, will not work out of the groove. Mr. Schafer has used this device for about three years and states that it has never given trouble of any kind. This stop could be adapted to other purposes, for stopping elevators, for instance.

## HOW TO MAKE AN S-WRENCH

From the scrap heap select a piece of good cast steel, ½x1 in. by 3 in. long (Fig. 1). Draw down the center and round the ends. At SS (Fig. 2) fuller to ¼ in. thick, and leave the middle a little thicker. Make holes

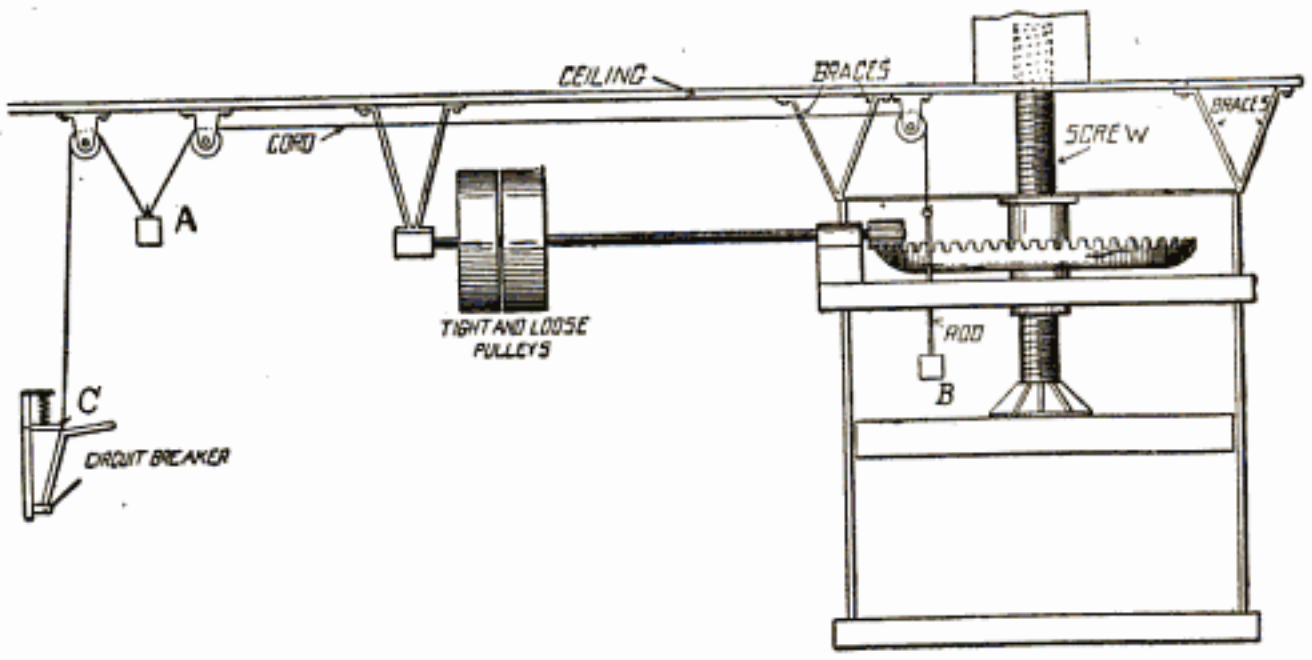

in the ends as shown by the dotted lines, Fig. 2, using a square punch. Put a flatter on and smooth up side nicely.

Cut out AA on both sides with a sharp thin chisel, which will spread the jaws. Round up again and shape like Fig. 3 to suit your taste. Heat to a cherry red and lay in some unslaked lime which will soften. Let it cool and then dress. Make one end for, say, ⅜, and the other for $\frac{5}{16}$, or any





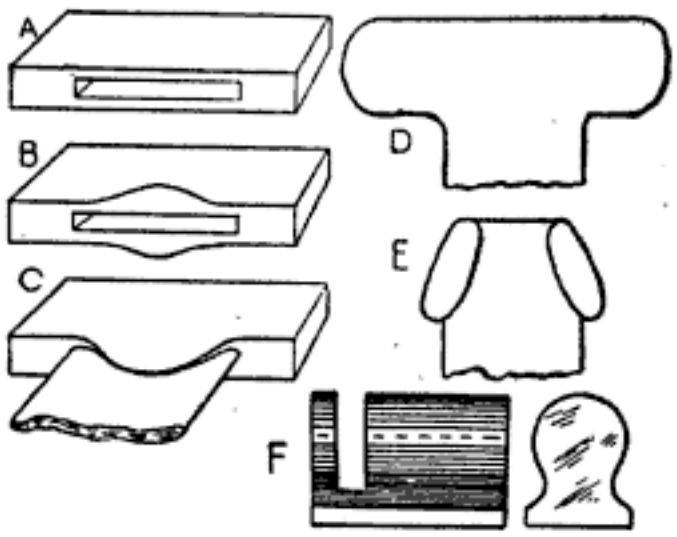
size you want. Now heat to a very low red. Lay it between two green pine boards or drop in linseed oil, says a correspondent of the Blacksmith and Wheelwright, and you will get a good color and a good temper.




**Automatic Stopping Device for Presses**

## MAKING A SPRING HEAD

There are many smiths who do not know how to put a head on the upper main leaf of an ordinary elliptic spring, says a correspondent of the American Blacksmith. The following is an excellent method:




**Making a Spring Head**

Cut off steel the length wanted, less ½ in. for each end. The instructions are for only one end, but apply to both. Take 3 in. of ⅝-in. square Norway iron. Split through from one side as at A, and have the split the width of the steel to be used. Now fuller as at B, insert steel as at C and weld. Then trim as shown by the dotted lines at D. The ears can be bent in the vise, without danger of injury from cold, shut and should be bent as at E. Now dress up thread in the tool F, after fullering between the ears. Fullering will bring the ears parallel and after dressing them, the holes are drilled.

Mechanics for Young America, an illustrated book for boys. Price, 25 cents.

## BORING ON THE TURRET LATHE

**Boring to Size vs. Boring Undersize and Re-reaming by Hand**

At one time I worked in a large manufacturing concern where all gears, sprockets, pulleys, collars, etc., were bored in the turret lathe by a system that, I admit, was new to me. I had worked in different shops, had seen many turret lathe fixtures and systems, but never before had I heard of boring articles undersize and reaming them to size by hand with an expansion reamer. The system I refer to could be bettered, in my estimation, by the suggestions offered below. Their boring was done by first running a drill, slightly smaller than the reamer, through, then reaming.

By use of a little oil and a new reamer a good fit could be secured, but it would not be advisable to keep buying new reamers; consequently when the reamer becomes slightly worn (which will happen in a very short time by continuous use) the bore will be small. If reamed dry, the bore will be too large, even with a worn reamer. The firm in question used oil on the reamer, which made the hole as small as possible, with the result that every piece had to be reamed by hand with an expansion reamer to obtain a good fit. In a large plant this labor of re-reaming will amount to a large sum in the course of a year.

I have often wondered why a system as explained below would not be satisfactory to others. I have rigged up turret lathes in this way, and it gave satisfaction in every respect. Furthermore work can be done more quickly, besides, no reamer is used.

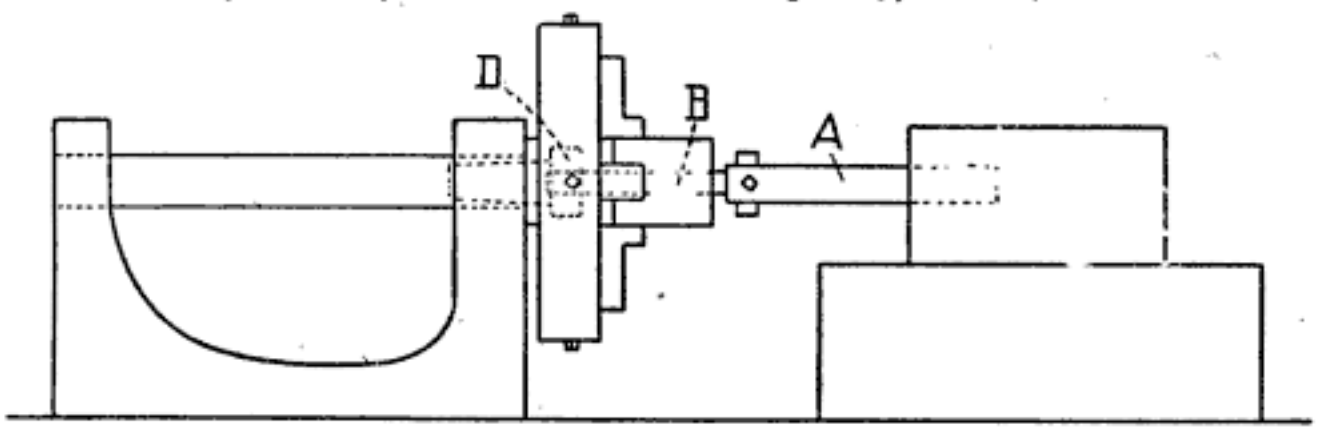



Fig. 1

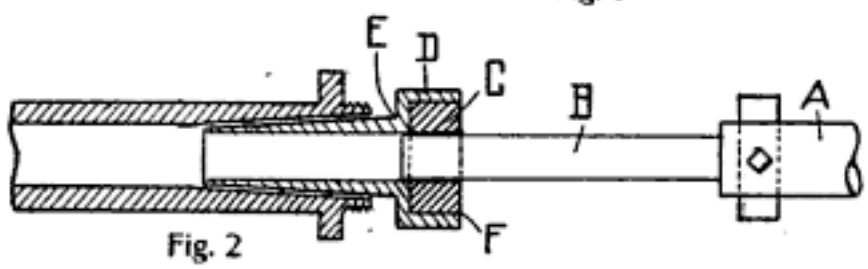



Fig. 2

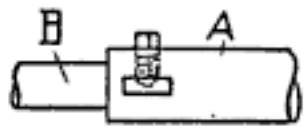



Fig. 3

Referring to the diagrams, Fig. 1 shows a view of the boring bar in position for boring. Fig. 2 is a sectional view of bar, bushing for same and lathe spindle. Fig. 3 shows the cutter in the bar and the method of holding it. In Fig. 1 and Fig. 2, A is the boring bar turned on end B, so as to pass through the core and enter the bushing C in the lathe spindle, which steadies the end of the boring bar. D is turned to fit in spindle with shoulder at E for bearing against the end of the spindle and is bored out at F, to receive different sized bushings, which are fastened in by a feather key and can readily be changed. The bushings could be placed directly in the spindle without the use of D, but D is used to keep the bore of the spindle from wearing; by frequent changing of bushings, etc.

The bar is fitted with cutters the same as a facing tool, but these are not held by a key, as they have to be centered exactly, because both sides cut and with a key too much time is lost in setting. The cutters are fastened as shown at A, Fig. 3. The cutter is countersunk to receive cone head set screw and it is turned to size while so fastened. It is obvious that when replaced, it will always be central and different sized cutters can be used by turning them to size in the same bar they are to be used in.

With the end of the bar supported in the bushing, all material can be removed in one cut and as the cutter is turned to size, and being straight from cutting edge, no reamer is necessary. One cutter can be ground an hundred times without changing the size of the bore.

While this method is very old to some, it will no doubt help someone who is still toiling away with a monkey wrench and an expansion reamer.—Contributed by Norman Baker, Hoopeston, Ill.

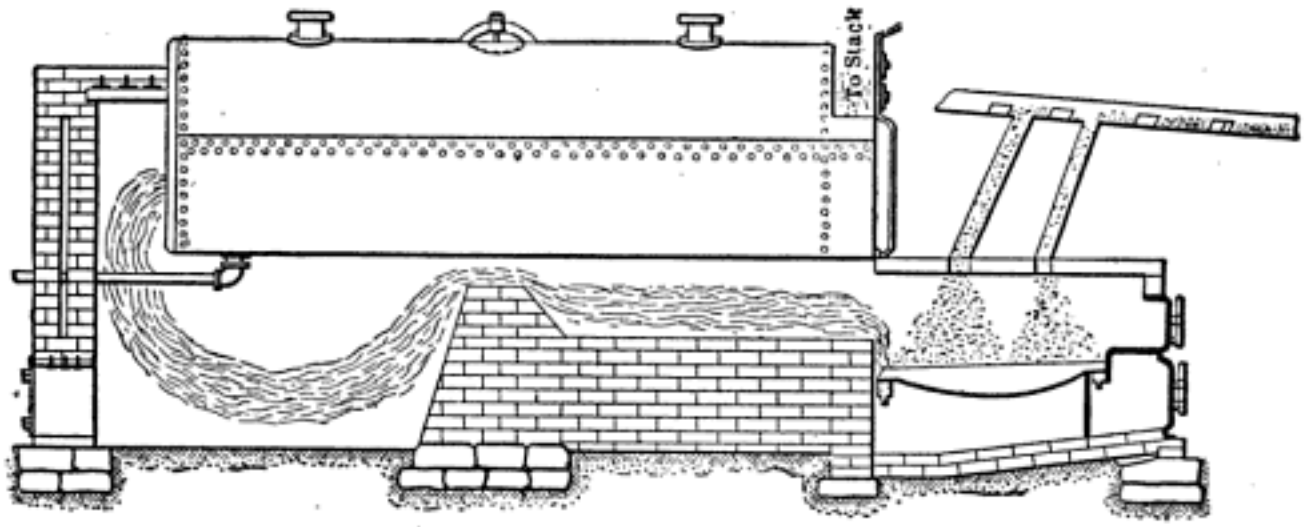
## HOW TO BURN SAWDUST

A furnace and boiler setting like the one shown in the diagram is an excellent arrangement for burning sawdust, says a correspondent of Power.

The boiler setting itself is like that usually used in a horizontal boiler, but the grates are in an oven or projection built in front of the boiler instead of being under it. The oven is about 10 ft. long and should be full width of the boiler, or if convenient, 2 ft. wider than the boiler is preferable. The grates should have ¼-in. openings.

The sawdust, brought by a mechanical carrier of some kind is dropped through two chutes on to the grates and lies in two cone-shaped piles that cover the entire grate surface.

The fire should be started with shavings or other dry material and will burn principally around the edges where the draft will force itself up through the fuel. When well ignited the surface of the cones will be covered with flames and the sawdust will burn furiously.




Arrangement for Burning Sawdust

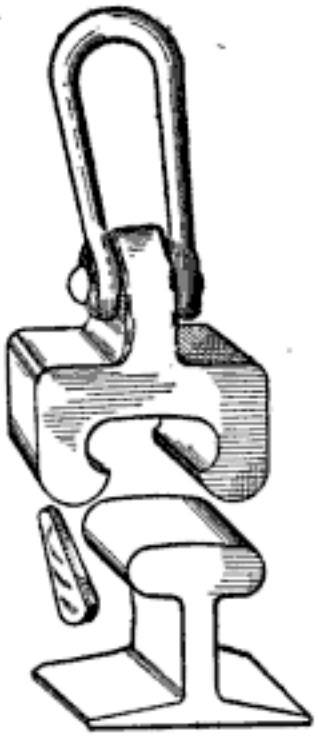
The supply of sawdust may be regulated by slides in the chutes. It is not necessary to use a firebar, simply fill up with the fuel and let it burn. To bank the fire at night fill the furnace well up to the top with the sawdust and level it off, close all doors and the damper and let it alone.

A threshing outfit equipped with a system of electric lights enables an Ohio thresherman to work till 10 p. m. during the busy season. The engine supplies the power for the dynamo and the lamps are attached to the separator.

If you want any machine or device and do not know where to get it, write us. Information free.

## ANOTHER SAFE RAIL GRIP

The illustration shows a rail grab made by F. A. Crans of 207 Williams St., Waverly, N. Y., and used by Mr. Foley, wrecking foreman of the Lehigh Valley R. R. tool train located at Sayre, Pa. Mr. Foley says of this grip:



Rail Grip

"We are using the rail grab or grip in our wrecking equipment and it is a first-class grip, as it can be used in any place, and will fit any rail from 58 lbs. to 90 lbs. We have two of these grips and we use them very often for a stop to put ahead of our steam crane on the rail at the end of the track to keep the crane from moving when we have a hard end pull."

Anyone wishing details of construction of this grip may secure them by writing Mr. Crans.

## REPAIRING A CRACKED WATER JACKET

A cracked water jacket in a gas engine is a common trouble. Often cylinders and cylinder heads that could easily have been repaired are consigned to the scrap pile on this account.

In repairing, when the crack is rather open, it is best to use a piece of sheet copper for the patch, as it can be hammered into almost any shape easily. The edges should be caulked to make them watertight, though sheet asbestos may be used as packing. The patch is best fastened on with small screws along the edges and not over an inch apart.

Small cracks may be repaired by forcing in solder with a blowpipe, or by driving a sharp-cornered cold chisel along the crack, making it wider and deeper near the outside, then pounding in a piece of lead wire or a narrow strip of lead and the job is done.—Contributed by Royal Wolfe, 915 S. Broadway, Lancaster, O.

We are always glad to receive contributions to this department from our readers. Make your story concise but plain.

## SOME ELECTRIC PLANT TROUBLES AND WHAT CURED THEM

In an extremely interesting series of articles on "Experience on the Road," H. L. Stephenson, an electrical expert, tells in the Electric Journal some of the things he saw, from which the following are selected:

### A RUNAWAY ENGINE.

A recent case of trouble with an engine will serve to illustrate the point. This particular engine was a small, high speed, piston-valve type, direct connected to a 75 kw. lighting machine to be driven at 270 r. p. m. When this outfit was started and the engine given full steam pressure, the first speed would probably be 276, and as quickly as another could be taken, 281, then 287, 293, 297, 301, 310, continuing to creep up slowly. With any load from ten kw. up, the speed regulation was very good, but whenever the load was thrown off, the speed would begin to creep. We ran it throttled until all of its parts had reached an even temperature, but with no better results. The engine-man then took out the valve to look for steam leaks but it seemed to be in good condition and a trial showed that we had not improved it. An improvised device showed that the governor did its work so that it looked reasonable to believe, despite our indicator cards, that there must be some error in the valve setting. This was checked over, and the piston was taken out and examined. We took cards until there was no more paper to fit the indicator. And so it went for three or four days, until we got hold of the theoretical curve such as engine builders send out as a sort of an advertisement.

In comparing the card with one of our no-load curves the trouble was as apparent as though it had been printed in words across the paper. The valve leaked steam. Taking the valve out for the second time, we peined the inside of the rings to spread them out thereby increasing their pressure against the walls of the steam chest. We had solved the problem, for engines are not made that run better than this one now does.

### A TRANSFORMER FIRE.

A telegraphic request, "Trouble with new transformer, send man at once," took the writer off once on an eighteen-hour trip. The customer had installed this unit and on putting it into service it gave entire satisfaction, but in two or three hours some one noticed smoke pouring from the transformer

house in such volumes that it was thought the whole building was on fire. An investigation showed that it was only the new transformer and a careful examination revealed nothing further than that the smoke came from the grease and dirt burning on two of its low tension terminals, which from all appearances had reached a temperature far above 100 degrees centigrade. The attendants were at a loss to account for this as these terminals were joined together by a short copper strap and were therefore necessarily at the same voltage and, of course, there could be no heating on account of a slight leakage of current jumping from one to the other. This transformer was of that type designed to give either 110 or 220 volts on the low tension side, and as it was operated on the latter voltage, this copper strap put the two windings in series. The reader can imagine the chagrin of the attendants when the trouble was remedied by sand papering this strap and the terminals and screwing up the bolts tight enough to make a good contact for carrying the current. As this transformer was run with a load very close to its rated capacity, we afterwards took the precaution to insert an additional jumper.

A TIME-HONORED TROUBLE.

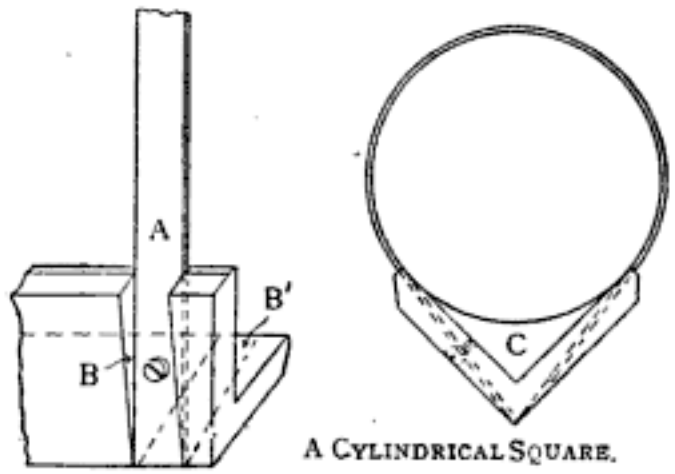
A paper of this kind would not be complete without mentioning some experience with the series fields of compound machines. Tell a roadman that a motor's speed is not right or that a generator will not hold up its voltage and the first thing that comes to his mind is the series field. This seems a simple thing, but any one with road experience can cite a number of cases where trouble was due to wrong connections on this part of the machine. It is not at all uncommon to find machines that have been run so long at an excessive speed to keep up the voltage at full-load, that the proper pulleys have been lost and when the trouble is discovered it takes a month or two before the change can be made and the generator belted properly.

Alternating-current apparatus is not altogether free from this same trouble. A good example comes to mind in the case of a composite wound generator which had been in service for two years, but only at the end of that time did it begin to receive anywhere near its rated load. A complaint was made that this machine would not hold up its voltage with the separately excited field having a drop of 110 volts direct current. As the reported full-load voltage was not excessively low we concluded that a bad power-factor was responsible for some of it and with that end in view an elaborate test was arranged to be taken in the presence of the officials of the power company. The engineer who went to the plant discovered that in all probability during the two years they had been running, the self-excited coils had been bucking against the separately excited winding and reversing this—well, the truth is, we do not care to hurt the feelings of any one by commenting on things of this sort. Reversing this cured the trouble.

## HOW TO MAKE AND USE A CYLINDRICAL SQUARE

In sawing off square a piece of metal tube or rod in the vice a round-square is needed, and the box square can be converted into one in the following way:

A thin flexible steel blade and a small cheese-headed screw will be required. Referring to the left-hand sketch, the blade A must be parallel its whole length. Cut slots BB directly in line with each other and at



A CYLINDRICAL SQUARE.

right angles to either edge of the square. In the right-hand sketch at C it will be observed that this slot tapers towards the edge. This is to bring the blade close to the work being marked off, says the Model Engineer, London. The marking is accomplished by drawing the blade around the work into the slot in the opposite side and scribing off.

## WEIGHT OF LEAD PIPE

The weight of lead pipe of any thickness and diameter may be determined by subtracting the square of the internal diameter of the pipe from the square of the external diameter (both in inches) and multiplying the remainder by 3.86. The result will be the weight in pounds per running foot.

## HOW TO BUILD A CHEAP WATER WHEEL

The wheel should be made of good hard pine and the dimensions given are for a wheel 10 ft. in diameter and 4 ft. wide, but a wheel of any size can be made in the same way and in proportion, says a correspondent of the Blacksmith and Wheelwright.

Gain eight pieces of joist 2 x 6 in. by 8 ft. long as shown at G, Fig. 1, and put them together in pairs (A A and B B, Fig. 2). Bolt the two pairs together, making eight spokes or arms, and forming one side of the wheel. Against the offset or depression of 2 in. at the end of every second spoke on each side, fit a piece 2 x 6 x 42 in. long, made

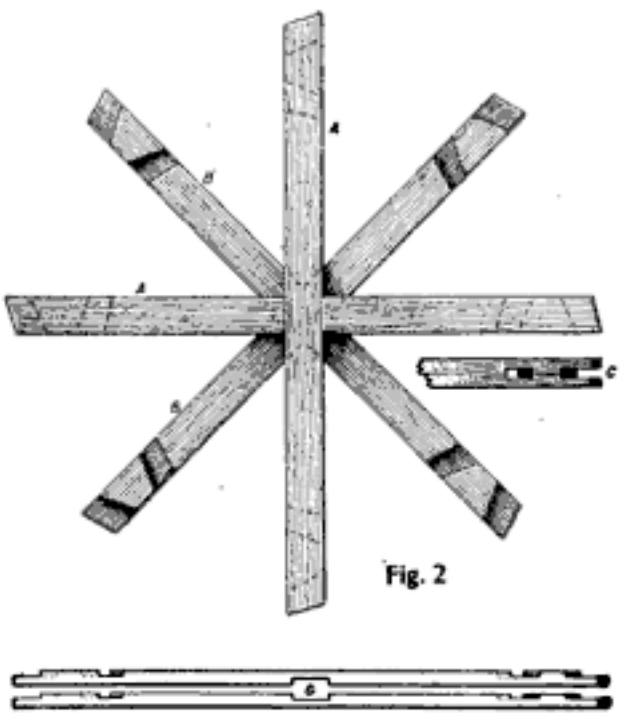


Fig. 2



Fig. 1

as shown in Fig. 4. This will make the spokes 4 x 6 in. Between each piece and its spoke, near the ends, gain in as at C, Fig. 2, for the standards for the buckets. F, Fig. 3, indicates the standards for the buckets. They should be 2 x 4 x 16 in., tapered, and bolted clear through as shown. The faces of the spokes at this stage will all be level. To the outside as at E, Fig. 3, bolt a cast-iron plate 18 in. in diameter. This plate should have a hub H, of about 4 in. on the outside for set screws or keyway for fastening it to the shaft, and a short hub on the inside to go into the wood. Have the shaft about 3 in. in diameter and the buckets about 10 in. deep, 10 in. on the bottom and 4 ft. long.

The other side of the bucket is made in exactly the same way and the parts then put together.

## CEMENT REQUIRED FOR SURFACING

The following table gives the amount of cement and sand required in several instances. From this table one can readily estimate other areas as may be required.

| Bbls. of Cement. | Bbls. of Sand. | Thickness of Coating. | Area Covered in Sq. Ft. |
|---|---|---|---|
| 1 | 1 | 1 inch | 67 |
| 1 | 1 | ¾ inch | 90 |
| 1 | 1 | ½ inch | 134 |
| 1 | 2 | 1 inch | 104 |
| 1 | 2 | ¾ inch | 139 |
| 1 | 2 | ½ inch | 208 |
| 1 | 3 | 1 inch | 140 |
| 1 | 3 | ¾ inch | 187 |
| 1 | 3 | ½ inch | 280 |

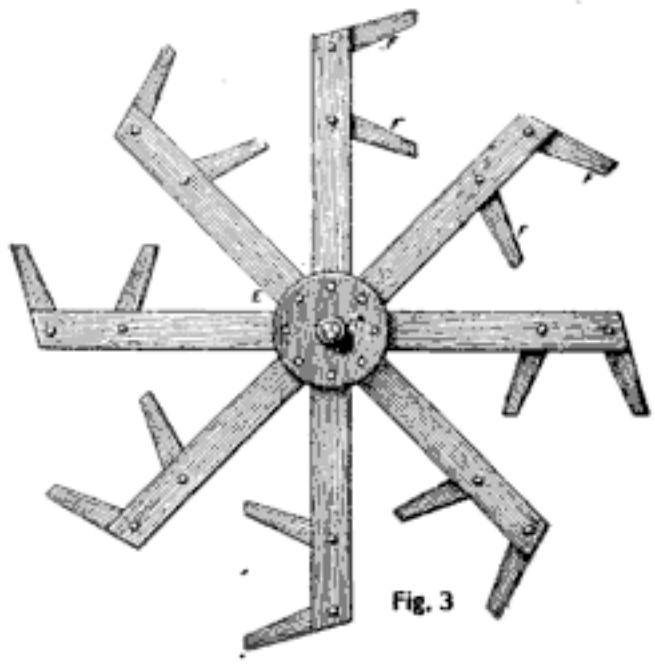


Fig. 3

Fig. 4

## MAKE THE SAW FIT THE WORK

"The right thing to do with any sawing machine is to use the smallest saw possible for the work." This is the deduction made by J. Crow Taylor in the Wood-Worker, after recounting how a man running a saw mill, thinking that there was no use in running a 16-in. saw for cutting a 1-in. board, cut down a number of thin and unsatisfactory 16-in. edger saws to 12 in. and secured excellent results, as well as saving power. By reducing the diameter of the saws, they were stiffened, and the volume of saw blade in the cut being reduced, a thinner saw could be run, with the same results produced with a bigger and thicker saw, requiring more power. Large collars are recommended for all kinds of circular sawing machines, also.

## TO KEEP SHOW WINDOWS FROM SWEATING

If the window has no partition between it and the store room, make one of ceiling boards or of glass. Glass is preferable. (See

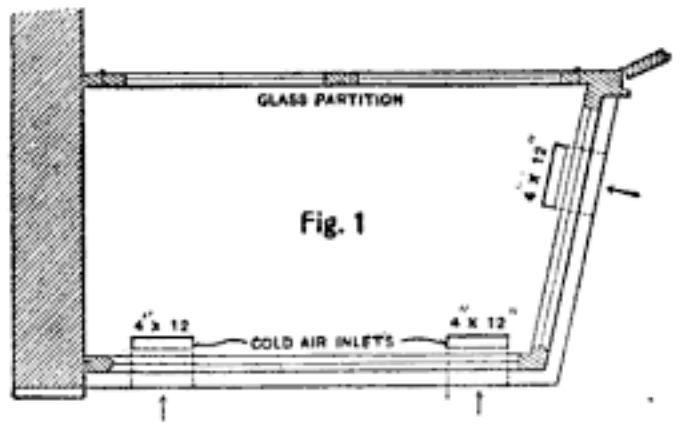


Fig. 1

Fig. 1, plan view.) In a window of ordinary size make three openings 4 or 5 by 12 in. Case these up tightly with galvanized iron or wood. A good way, says a correspondent of the Metal Worker, is to put in galvanized iron, then on top of the floor on the inside over the whole tack a piece of ¼-in. mesh wire screen, using small staples to

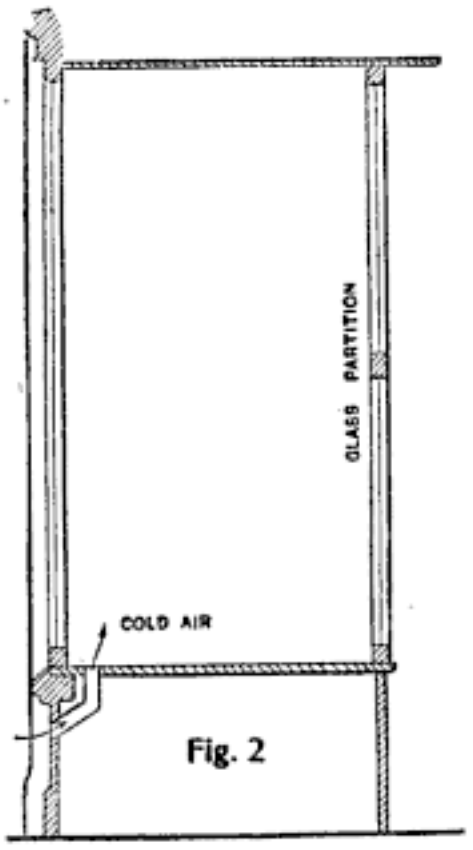


Fig. 2

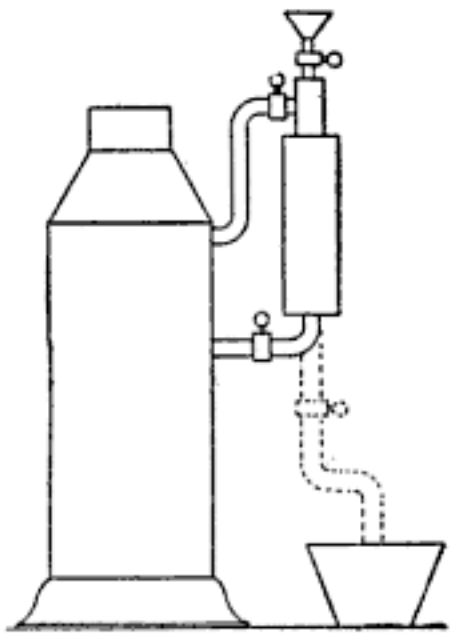
fasten it with. Fig. 2 is a sectional elevation. If this method is followed there will be no further trouble from sweating.

In lacing belts the pointed ends of the laces may be stiffened and made easier to insert by burning them.

## IMPROVED EMERGENCY BOILER FEED

In regard to the emergency boiler feed described in our July number, A. G. Knight, of La Salle, Ill., writes as follows:

"I understand the emergency boiler feed was like the accompanying sketch. In place of the funnel on top of the pipe, the party could have run a pipe, as shown by dotted line and supplied with a valve; he could have poured the water into the tub on the floor. When the two valves connecting his apparatus to the boiler were closed the steam in the big pipe would condense, causing a partial vacuum. Then on opening the



valve to the tub the water would be forced up into the large pipe by atmospheric pressure."

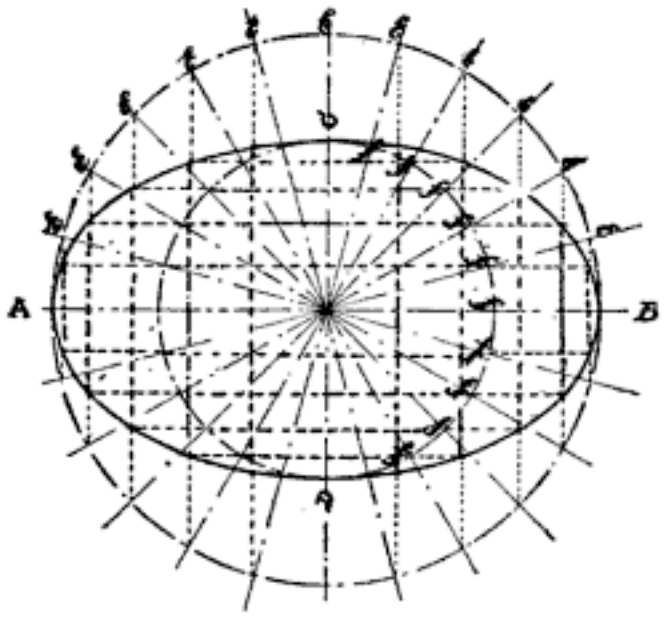
## HEATING IRON IN COLD WATER

A lead-lined glass or porcelain vase or cupola filled with acidified water, to which is connected a strong positive conductor and a pair of tongs with insulated handles attached to a flexible negative conductor will constitute the forge and furnace of the future, declares Science and Art of Mining. Into the sour water the smith plunges his piece of iron, manipulating it with a pair of insulated tongs. The water is agitated with a boiling motion immediately, and the great resistance created brings the iron first to red, then to white heat and so quickly that that portion of the iron not immersed is but slightly warmed.

Is there anything you want but don't know where to get it? Write Popular Mechanics. Information free.

## SIMPLE METHOD OF DRAWING AN ELLIPSE

An ellipse is a figure that is incorrectly drawn more often than any other geometrical design. A simple way of developing and laying out an ellipse is shown in the illustration. As all ellipses have two diameters, viz: major and minor, it is necessary to know these two points before one can be drawn.




**To Draw an Ellipse**

Describe a circle with the length of the major axes A B of the ellipse for its diameter; then describe another circle, using the same center as the first circle and having for its diameter the length of the minor axes C D.

Divide the circle in any number of equal parts—the more, the easier to draw and the more perfect the figure will be. The figure in the illustration is divided by twelve lines passing through the center. Draw lightly the perpendiculars, using the points of intersection on the outer circle marked "e," then the horizontal lines indicated "f." By then connecting the first points of intersection, e and f, as shown in the sketch, a perfect ellipse will result.

Any ellipse may be drawn in this way and it saves the trouble of making the trammel and guider that are so commonly used.—Contributed by Jos. E. Stanton, Los Angeles, Cal.

## FLEXIBLE VARNISH

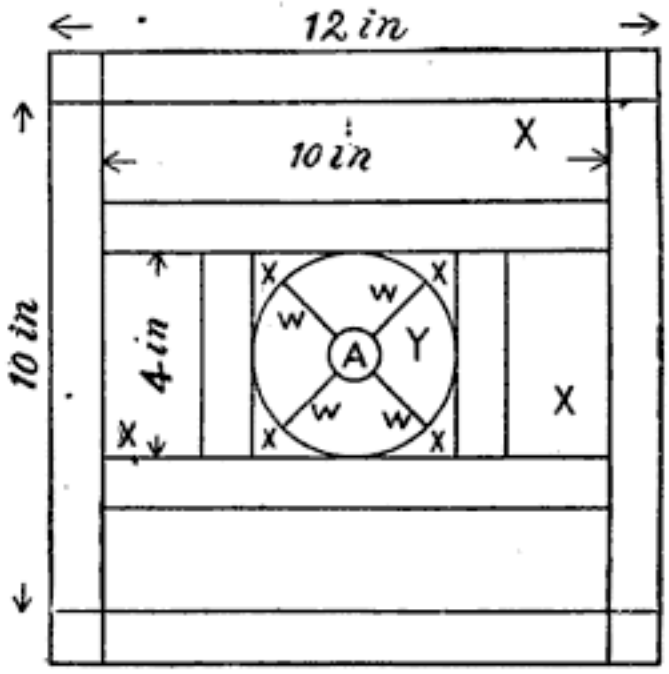
This varnish is sometimes called "balloon varnish." Boil together 2 gal. linseed oil, 6 oz. copperas, 6 oz. sugar of lead and 1 lb. litharge, stirring constantly. When it strings well, remove from fire and when cold, thin, if necessary, with drying oil.

## METHOD OF PROTECTING WATER PIPES FROM FREEZING

To properly protect pipes is perhaps a little expensive, but the extra expense will save greater expense in the long run, says the Rural New Yorker.

Make a 4-in. pipe of heavy galvanized iron in sections like stove pipe, each section made to slip over the next. In every second section run four copper wires through holes in the pipe on four sides and opposite to each other. Solder the wire on the outside and solder the holes up tight. As each section is put on over the water pipe fasten the wires so that the water pipe is in the middle of the galvanized pipe. If it is not possible to disconnect the water pipe in order to slip the protection pipe over it, crimp and fasten at the top and bottom with small short stove bolts, having the screw heads on the outside. Put the boards on as shown in the diagram. Be sure to always break the joints. Leave the pipes bare.

In the diagram, A, is water pipe, W, wires for holding pipe in the center, the circle represents the 4-in. galvanized iron pipe, and the rest are 1-in. boards carefully trued. Put two thicknesses of paper under each




**Protecting Water Pipes**

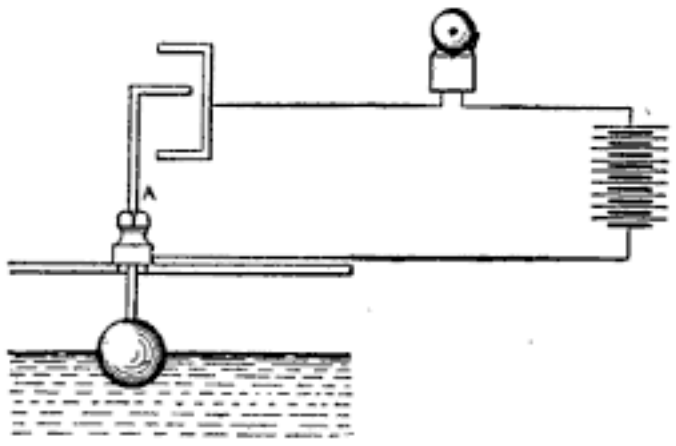
joint to act as an air-tight washer. X represents dead air spaces and Y inner dead air space.

Do not let the water run in the hope of preventing freezing, unless the supply is from a windmill. On very cold nights set a lamp in the box to heat the air. Have the chimney of the lamp of tin 8 or 10 in. long, and fit it tightly through a hole in a piece of tin under the box. Use a ½-in. wick.

This plan was tried on a 60-ft. standpipe under a tank and a 32 ft. pipe each 1½-in. diameter, and was found to work to perfection

## SIMPLE HIGH AND LOW WATER ALARM

A high and low water alarm that is exceedingly simple and wholly dependable is designed for use at the top of the boiler. The bell is installed and connected up as shown




**High and Low Water Alarm**

in the illustration. Contact is provided for by a rod of very small diameter attached to a float. The packing, says the Engineer's Review, is soaked in oil and ground graphite so there is the minimum of friction on the rod.

## HOW TO WIND A SINGLE CYLINDER MOTOR

To wind a single cylinder motor, using three and four terminal coils, connect the primary wires to the end binding posts, and always have the secondary on top of the coil. The Motor Age gives a number of diagrams showing the arrangement for several numbers of terminal coils.

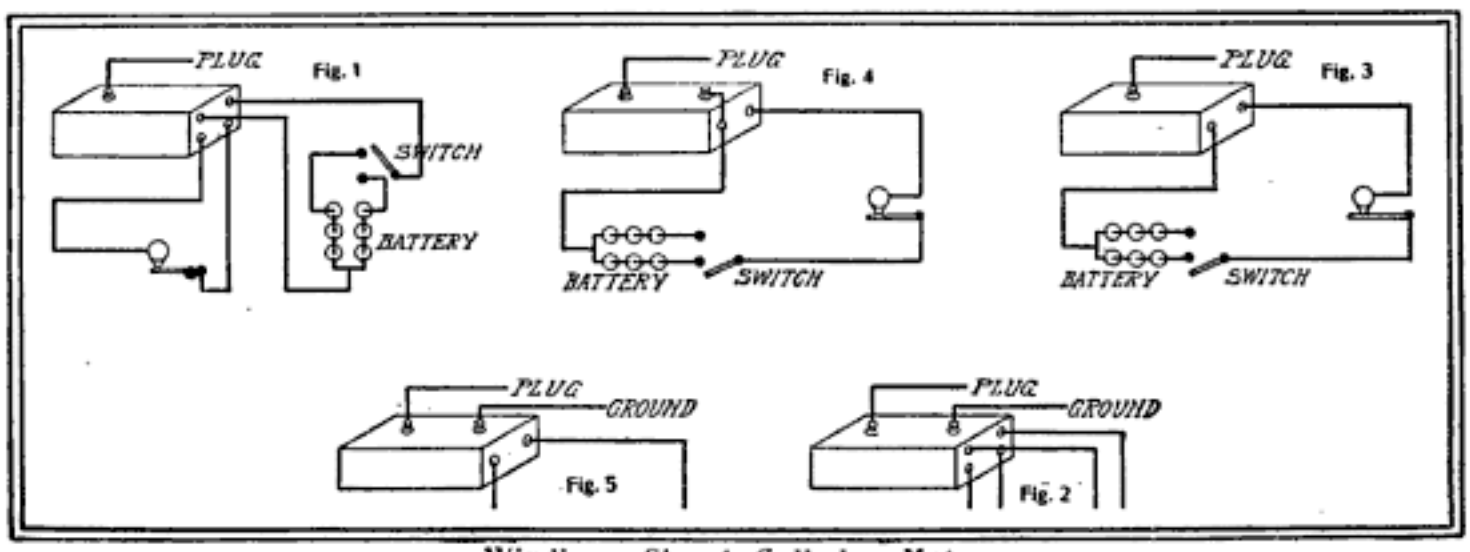
Fig. 1 represents a five-terminal coil, with two sets of batteries and but one secondary terminal. A wire is shown connected to the circuit breaker cam, but in making the connections this wire is always grounded on the engine. Fig. 2 shows a six-terminal coil, the primary being connected as in Fig. 1, and the extra secondary is grounded to the motor. Fig. 3 is a three-terminal coil, Fig. 4 a four-terminal coil, and Fig. 5 is another way to connect the coil of Fig 4. These diagrams represent the usual methods of connecting coils with terminals from three to six.

## MATCHES FOR CUTTING GAGE GLASSES

The easiest method of cutting gage glasses is with red-headed matches. Measure off the glass, wet the head of a match thoroughly, and with it mark a circle on the inside of the glass at the point where it is to be cut. Strike another match, hold it on the outside of the glass under the marked circle and the glass will break off with smooth edges at the point marked. The trick can be done with but one match, says a correspondent of Power, and is so simple and easy that a gage cutter is wholly unnecessary. If you cannot reach far enough into the glass the first time, make a second cut.

## GRADE THE STEAM PIPE

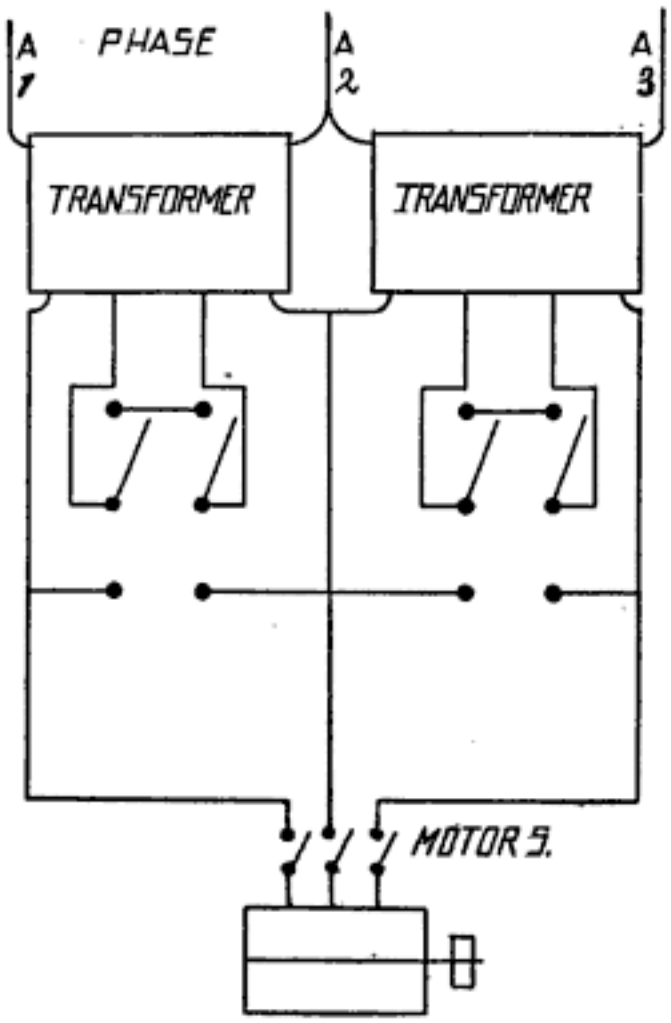
The steam pipe should be graded from the boiler towards the engine, says the Practical Engineer, because the water of condensation can move in no direction save along with the steam. Provision for catching or disposing of this water should be made at the engine.




**Winding a Singel Cylinder Motor**

## SUBSTITUTE FOR AUTO STARTER

We recently had an auto starter for a 50-hp. three-phase induction motor burn out and were badly in need of motor, but could not use same on account of large starting current and our small generating capacity, writes H. H. Cloyd, of Trenton, Mo.




Auto Starter Substitute

The transformers for this motor were located close by and with the use of two D. P. D. T. switches I made the transformers take the place of the starter by cutting the starting voltage from 200 to 100 volts at transformers' terminals. With this voltage the motor started with very little jerk on our line and with about 60 per cent of its rated load. The enclosed rough sketch will show use of switches.

One 4-pole D. T. switch would be much better, as with the two D. P. D. T. switches both must be thrown at the same time. This will also apply to any two-phase motor, also three-phase and three transformers, provided another switch is added.

Referring to sketch, when the switches are thrown downward the secondary coils of the transformers are in multiple, giving the motor 100 volts starting current. Throwing switches upward simply short circuits two middle transformers' leads, throwing secondary coils in series, giving motor 200 volts, or its rated voltage. The upper switch terminals act simply as single pole switches.

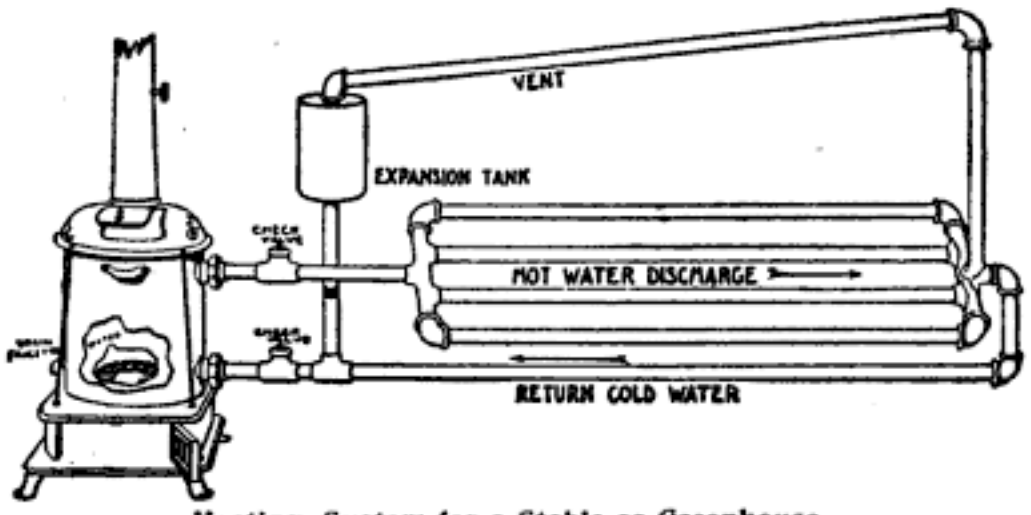
This idea, though not always practical, might be of some good if any one were caught as we were without immediate means of repairs.

## SIMPLE BABBITT LADLE

When rebabbitting stern bearings, or any time I need a ladle, I take a piece of 2-in. gas pipe, 18 in. long and put an elbow on one end and the ladle is made. To make the metal run readily take a good chisel and dig a trench through the threads on the elbow.—Contributed by E. S. Stout (marine engineer), San Pedro, Cal.

## HEATING SYSTEM

The system of piping shown in the illustration used in connection with a small laundry or tank heater is suitable for heating a stable, small conservatory or a chicken house. The system is cheap and simple to rig up, says Domestic Engineering. The illustration explains the connections and most of the materials can be picked up at home.




Heating System for a Stable or Greenhouse

# CHEMISTRY FOR MECHANICS

By M. G. KOPF

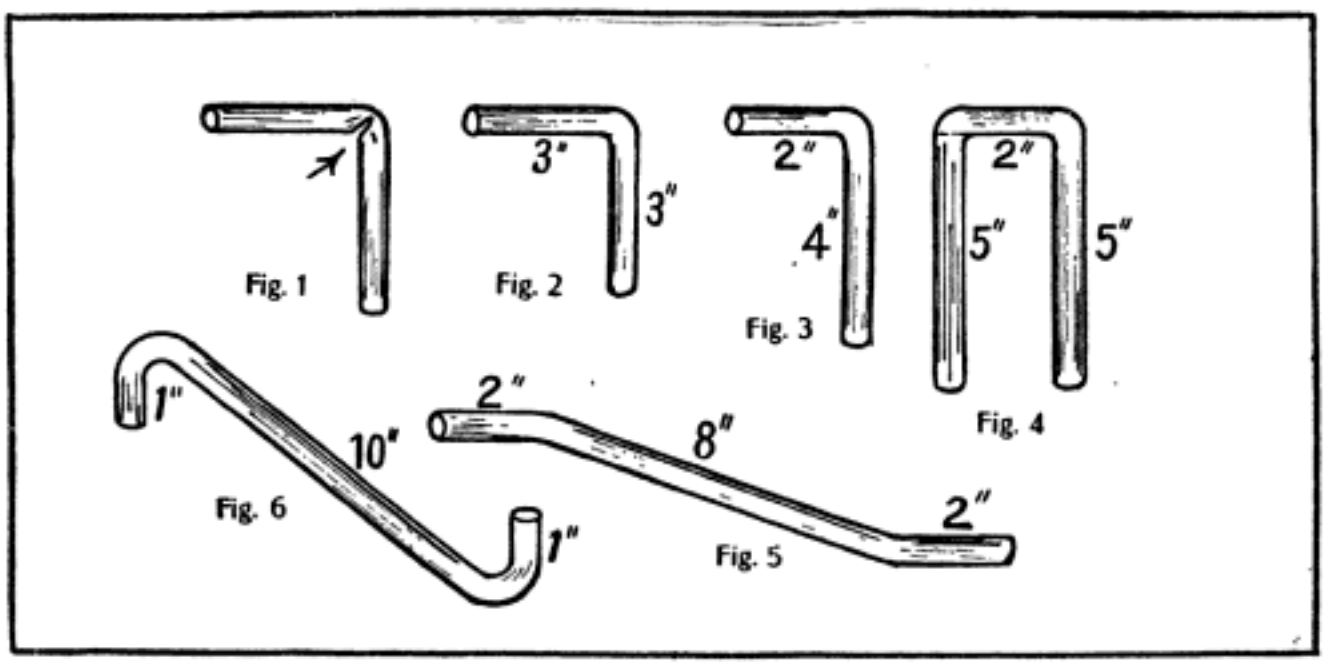
This is the second of a series of short lessons on practical chemistry, particularly adapted to the mechanic. The professional chemist is now considered indispensable in the larger manufacturing industries. We have the iron smelter sending samples of iron to the chemist, to be analyzed, so that he will be able to grade it as regards strength and purity. We have the food chemist, constantly in watch of our health. There is the agricultural chemist transforming arid deserts and wastes into productive farms and fields. In the shops we wonder why one tool breaks sooner than another, why some oils are better than others. We cannot all be chemists, but every one may easily obtain some knowledge of the science in its immediate relation to the things which are closely connected with his every-day work. These articles will all be written in plain simple language "so you can understand it."—Editor's Note.

## PART II.

The following articles will be needed: A fish tail burner (25 cents); a few feet of $\frac{3}{16}$-in. soft glass tubing (about 2 cents per ft.); a few inches of copper wire; a pound of nitric acid (6 cents); a few ounces of copper sulphate (blue vitriol, 5 cents); a 1½ to 2-in. glass funnel (10 cents); a package of 9 c. m. filter papers (10 cents); a wire gauze (10 cents); and a ring stand with three rings (65 cents).

### HOW TO BEND GLASS TUBING.

Cut two pieces of tubing 6 in. long, and three pieces 12 in. in length. Place the fish tail burner on the bunsen burner and turn the draft to give a luminous flame. Tubing having thin walls should be bent with a luminous flame, but tubing of hard glass and having heavy walls should be bent with the non-luminous flame. Take one of the 6-in. pieces of tubing and hold it in the flame, rotating constantly, so that the central portion is heated. When the tubing becomes soft and has a tendency to bend, withdraw it quickly from the flame and bend it just as one would bend a small copper wire. There are several things to be observed when bending glass tubing and these are, that the tube is hot enough; that it is evenly heated; that it is constantly rotated, so as to heat it evenly; that about one to two inches of the tubing is heated; that, after hot enough, the tube be bent quickly, and finally that the bend be allowed to cool slowly. To procure a slow cooling the bends should be held in the upper part of the luminous flame until a black deposit of soot covers it. This deposit will protect the tubing from the cold air and allow it to cool slowly and thus obtain good annealing. If the tubing were not heated evenly or if it were heated in one spot (as would be the case with the ordinary flame of the bunsen burner) a kinked bend would result (See Fig. 1). Heating the tube evenly and bending rapidly gives a bend as shown in Fig. 2. Observing the various points above and practising a little will bring success in glass tube working. Having bent a tube




**Bending Glass Tubes**

as shown in Fig. 2, bend the remaining pieces according to the Figs. 3, 4, 5 and 6. Preserve these tubes for future use.

## ELEMENTS.

Chemists have agreed to adopt certain symbols denoting the atoms or particles of the various elementary forms of matter. These elementary forms of matter are called "Elements," and they are substances that cannot be decomposed, i. e., they cannot be separated into any simpler substances. The elementary substances were given names denoting, in a number of cases, a peculiar property of that element; and in other cases they were named from the city in which they were discovered, or from the discoverer, and so on. The symbols are taken from the first or initial letter of the ordinary name of the element. For example, Boron, B; Carbon, C; Iodine, I; etc., etc. In a number of cases the symbol comes from the initial letter of the Latin name for the element. For example, Antimony, Sb, from Stibium; Iron, Fe, from Ferrum; etc., etc. When only one element is known, whose name begins with a certain letter, that letter is used as the symbol, but when two or more are known, the names of which begin with the same letter, that one best known or first discovered is generally designated by the letter, while the others are designated by the first two letters or by the first and third letters and so on, e. g., Carbon, C; Chlorine, Cl; Calcium, Ca; etc. In the table shown, the name of the element, its symbol, its discoverer, date of discovery and physical state is given. These elements, with their symbols, should be memorized as they are used.

## COMPOUNDS AND MIXTURES.

A compound is a combination of two or more elements chemically united in *definite* proportions.

A mixture is a combination of two or more elements in any proportions, the resulting substance still retaining the properties of its constituents.

In a chemical combination the substance resulting from the combination has properties entirely different from the original constituents.

Powder a piece of marble and put a little in a test tube. Add enough water to half fill the test tube. Heat with the bunsen burner for a moment or two and then filter into a test tube. The heating should be done carefully and the test tube shaken so as to slowly and thoroughly heat the liquid. To filter take one of the filter papers and fold

## ELEMENTS AND SYMBOLS.

| Element | Symbol | Discovery | State |
|---|---|---|---|
| Aluminum | Al.$^{iii}$ | Wohler, 1828 | Solid |
| Antimony | Sb.$^{iii}$ | Valentine, 1460 | Solid |
| Arsenic | As.$^{iii}$ | Schroeder, 1694 | Solid |
| Barium | Ba.$^{ii}$ | Davy, 1808 | Solid |
| Bismuth | Bi.$^{iii}$ | Agricola, 1529 | Solid |
| Boron | B.$^{iii}$ | Davy, 1807 | Solid |
| Bromine | Br.$^{i}$ | Balard, 1826 | Liquid |
| Cadmium | Cd.$^{ii}$ | Stromeyer, 1817 | Solid |
| Calcium | Ca.$^{ii}$ | Davy, 1808 | Solid |
| Carbon | C.$^{iv}$ | Ancients | Solid |
| Chlorine | Cl.$^{i}$ | Scheele, 1774 | Gas |
| Chromium | Cr.$^{iv}$ | Vanquelin, 1797 | Solid |
| Cobalt | Co.$^{ii}$, $^{iv}$ | Brant, 1733 | Solid |
| Copper | Cu.$^{ii}$ | Ancients | Solid |
| Fluorine | F.$^{i}$ | Knox, 1836 | Gas |
| Gold | Au.$^{i}$, $^{iii}$ | Ancients | Solid |
| HYDROGEN | H.$^{i}$ | Cavendish, 1766 | Gas |
| Iodine | I.$^{i}$ | Courtois, 1811 | Solid |
| Iron | Fe.$^{ii}$, $^{iv}$ | Ancients | Solid |
| Lead | Pb.$^{ii}$ | Ancients | Solid |
| Lithium | Li.$^{i}$ | Davy, 1818 | Solid |
| Magnesium | Mg.$^{ii}$ | Bussy, 1830 | Solid |
| Manganese | Mn.$^{ii}$ | Galm, 1774 | Solid |
| Mercury | Hg.$^{ii}$ | Ancients | Liquid |
| Nickel | Ni.$^{ii}$ | Cronstadt, 1751 | Solid |
| Nitrogen | N.$^{iii}$ | Rutherford, 1772 | Gas |
| OXYGEN | O.$^{ii}$ | Priestly, 1774 | Gas |
| Phosphorus | P.$^{i}$, $^{iii}$ | Brand, 1669 | Solid |
| Platinum | Pt.$^{ii}$, $^{iv}$ | Wood, 1741 | Solid |
| Potassium | K.$^{i}$ | Davy, 1807 | Solid |
| Selenium | Se.$^{ii}$ | Berzelius, 1817 | Solid |
| Silicon | Si.$^{iv}$ | Berzelius, 1823 | Solid |
| Silver | Ag.$^{i}$ | Ancients | Solid |
| Sodium | Na.$^{i}$ | Davy, 1807 | Solid |
| Strontium | Sr.$^{ii}$ | Davy, 1807 | Solid |
| Sulphur | S.$^{ii}$ | Ancients | Solid |
| Tin | Sn.$^{ii}$ | Ancients | Solid |
| Zinc | Zn.$^{ii}$ | Paracelaus, 16— | Solid |

it through the center; then fold again at right angles to the first, which leaves the paper in the form of a section of a circle; now, by inserting the apex of the section into the glass funnel, the paper may be opened out in the form of a cone that will closely fit the funnel. It is best to wet the paper before filtering. After filtering the solution above you will have a white substance remaining on the paper and a clear liquid in the test tube. The white substance is known as the *residue* and the clear liquid as the *filtrate*. Taste the filtrate. Put a small amount in an evaporating dish and evaporate to dryness. To evaporate place the wire gauze on a medium ring and fix the ring on the ring stand high enough to allow the bunsen burner to be put under it. Place the evaporating dish on the

gauze and heat. On evaporating nothing is left. On tasting the filtrate it does not taste much different than ordinary water. These then show that there is no change and that marble and water form a simple mixture and do not combine to form a compound. Next add some salt and marble to a test tube half full of water and repeat the above operation. The taste of the liquid is salty and on evaporating we have a substance left which, on tasting, is found to be salt. This shows that salt is soluble in water and that a mixture has formed since the liquid has the property of its constituents, and also since no new substance has formed. Is this last experiment a chemical or physical change?

Add next, to a small piece of copper foil or wire in a test tube, a few drops of nitric acid ($HNO_3$). Warm a little and when you have a solution, evaporate it just to dryness. A bluish green substance is obtained. When the copper is acted upon by the $HNO_3$ a green solution results and reddish brown fumes are given off. The residue in the evaporating dish is different than copper (Cu), it is copper nitrate [$Cu(NO_3)_2$]. This then is a substance entirely different than Cu or $HNO_3$ and therefore a compound of $HNO_3$ and Cu has formed. Chemical or physical change? Is blue vitriol a mixture or a compound? Blue vitriol ($CuSO_4$) is a compound because it is made from definite proportions of Cu and $SO_4$, and because it has different properties than either Cu, S, or O.

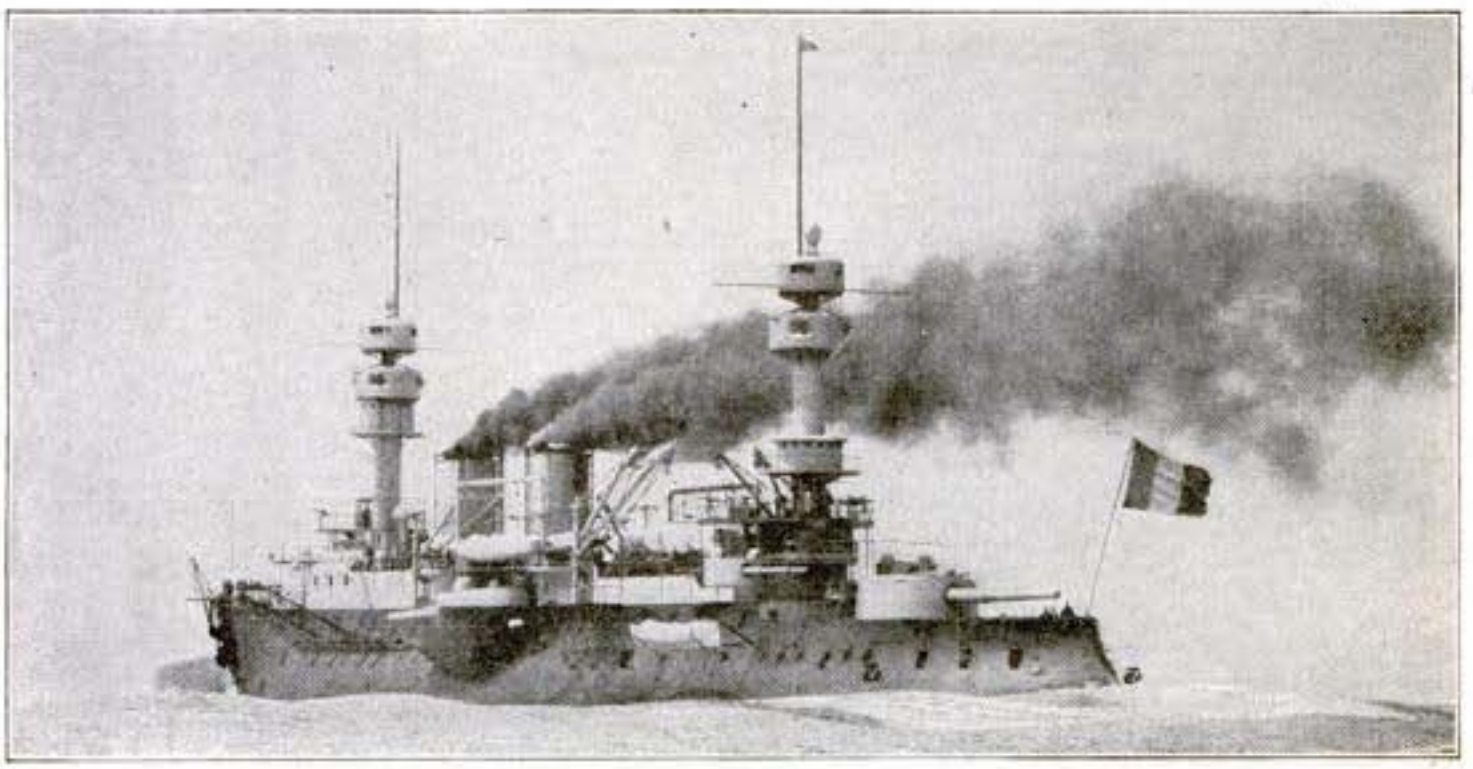
## THREE STATES OF MATTER.

Matter exists in three forms; viz., Solid, Liquids, and Gases.

Fill a test tube ⅓ full of sulphur and gently apply heat, noticing the change in appearance of the sulphur as the temperature increases. Increase the heat until the sulphur boils. When we begin we have a solid; after heating, a liquid, and we find that on the sides, near the top, sulphur condenses in yellow drops. There must then be something besides a solid and liquid and this must be a gas. We have then the three states of matter illustrated in this simple experiment. Repeat the above experiment, using a small piece of camphor instead of sulphur.

Solids do not readily change their form. Liquids do readily change their form. Gases always tend to expand and change their form.

In the next part we will take up Distillation, Crystallization and Oxygen, with a study of the flame of a bunsen burner and the changes that take place in a coal stove, introducing how to write formulas and equations.



**French Flag-Ship "Jaureguiberry"**

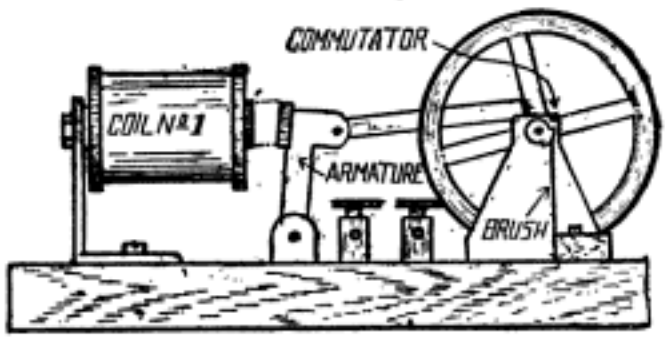
The flagship of the French squadron, the "Jauréguiberry," was launched in 1893 and is of 11,324 tons. Her armament consists of two 12-in. guns, two 8-in. guns and twenty-four quick-firers of various calibres. Her maximum speed is 18.10 knots.

# MECHANICS FOR YOUNG AMERICA

## HOW TO BUILD AN ELECTRIC ENGINE

This engine, if carefully made, presents a neat appearance and is capable of running toy machinery on very low current strength —the one I made ran satisfactorily on 1⅞ amperes.

The coils may be those of an old electric bell, mounted on a light piece of angle-iron, at a height of not more than one inch from the baseboard. The fly-wheel standard,




**Simple Electric Engine**

crank-rod and armature may be made out of galvanized iron, No. 16 being most suitable. A small valve-wheel makes a very good fly-wheel, but care must be taken in mounting it upon the shaft, for if the shaft is not in the center the engine will not run smoothly.

Make the shaft to extend on each side of the two bearings, so that the commutator may be atached to one side and so the other side may be bent into the form of a crank. On the commutator side place a brush in such position that during every revolution the circuit will be alternately opened and closed. Arrange the commutator so that the circuit will be closed either when the handle is at the top or when it is at the bottom, which makes no difference, except for the direction in which the engine will run.

Let us suppose that the crank is pointed downward. The circuit is now closed by the commutator and the armature is attracted by the electro-magnet, but, as it approaches the magnet, the circuit is broken and the fly-wheel pulls it back again, only to be attracted when the circuit is again closed.

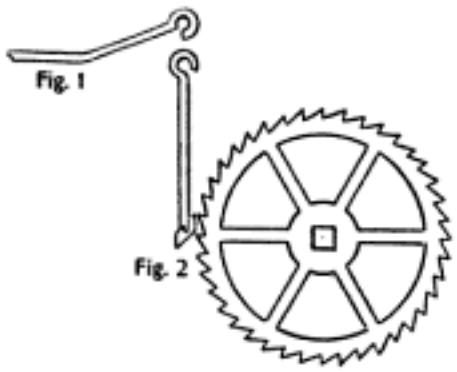
By adjusting the commutator, several different speeds may be obtained, as well as reversing the engine accomplished, which is done by placing the crank so that it points upward, then twisting the commutator around so that the circuit is closed.—Contributed by Warren B. Weyrick, 4 Russell Ave., Akron, O.

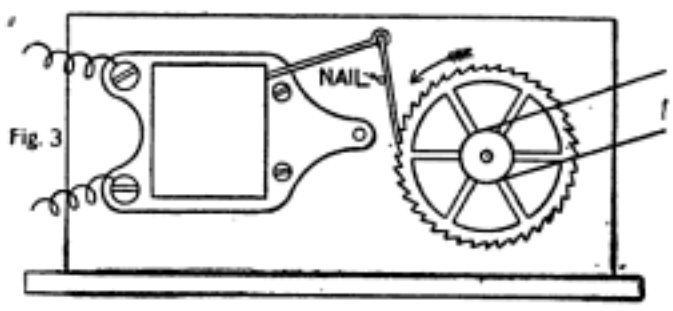
## NOVEL ELECTRIC MOTOR

The materials necessary to make this motor are an old electric bell of the "buzzer" type and a cog-wheel from an old clock.

Remove the hammer-head and gong from the bell, then bend the end of the hammer into a loop, as in Fig. 1. Now make a little wire catch like Fig. 2, and fasten its loop into the loop of the hammer. Mount the bell on a small board as in Fig. 3 and fasten the cog-wheel almost on a line with it. Now press down the hammer and place a nail in the position shown in the diagram so that the catch touches one of the teeth.

Fasten the board in an upright position and attach two dry batteries to the binding




**Novel Electric Motor**

posts. If properly connected, the fly-wheel will turn quite rapidly and with amazing force for so small a machine. The machine, however, has a fixed direction as shown by the arrow, but the belting can be arranged so as to send the models in a reversed direction if required. The materials for the motor should not cost more than 25c for the bell and if you have an old bell it will cost next to nothing.—Contributed by Fred C. Curry, Brockville, Ontario.

# HOW TO MAKE A SAILOMOBILE

By Frank Mulford, Shiloh, N. J.

I had read of the beach automobiles used on the Florida coast; they were like an ice boat with a sail, except they had wheels instead of runners. So I set to work to make something to take me over the country roads.

I found and used seven fence pickets for the frame work, and other things as they were needed. I spliced two rake handles together for the mast, winding

Photograph by Mrs. C. J. Lupton, Shiloh, N. J.

**Sailomobile Built by Frank Mulford**

the ends where they came together with wire. A single piece would be better if you can get one long enough. The gaff, which is the stick to which the upper end of the sail is fastened, is a broomstick. The boom, the stick at the bottom of the sail, was made of a rake handle with a broomstick spliced to make it long enough. Mother let me have a sheet, which I put down on the floor and cut in the shape of a mainsail. The wind was the cheapest power to be found, thus it was utilized; the three wheels were cast-off bicycle wheels.

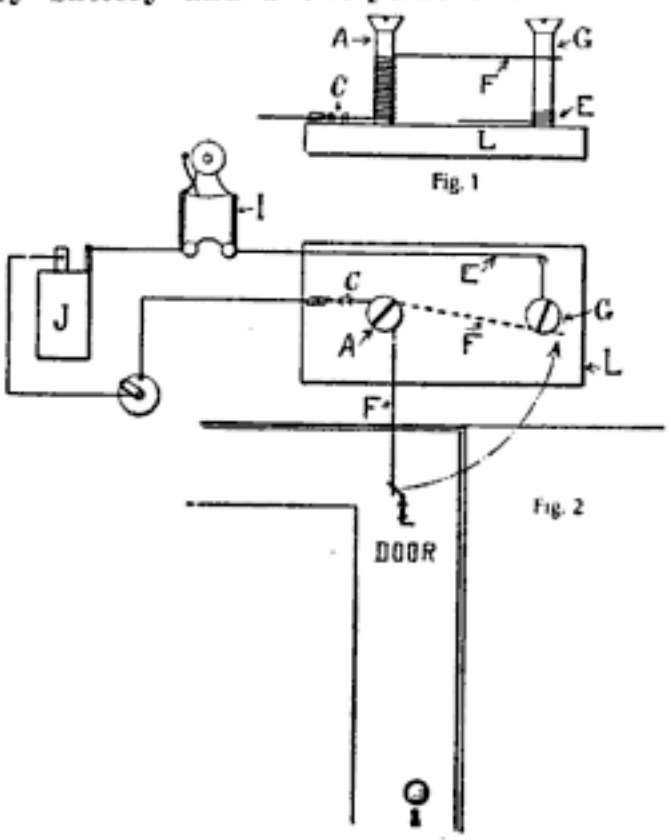
I steer with the front wheel, which was the front wheel of an old bicycle with the fork left on. The axle between the rear wheels is an iron bar which cost me 15 cents, and the pulley which raises and lowers the sail cost 5 cents. Twenty cents was all I spent, all the rest I found.

A saw, hammer, and brace and bit were the tools used. Slats made the seat and a cushion from the house made it comfortable, and in a week everything was ready for sailing.

Once it was started with only my litle cousin in it and I had to run fast to catch up.

## HOW TO MAKE A NOVEL BURGLAR ALARM

The only materials required for this device are a small block of wood, two screws, some copper wire, an old spring, an electric bell, a dry battery and a one-point switch.




Burglar Alarm

The illustrations show how these parts are put together and the letters used indicate as follows:

A and G, screws; B, old mouse trap spring; C, anchor for spring; D, wire to hold F back at night, or when alarm is set; E, copper wire running from G to bell; F, straight part of spring which, when released from D, completes the circuit; H, same as E, but connected at G; I, electric bell; J, dry battery; K, a one-point switch to be set on only when burglar alarm is set, otherwise bell will ring all the time; L, base for the alarm.

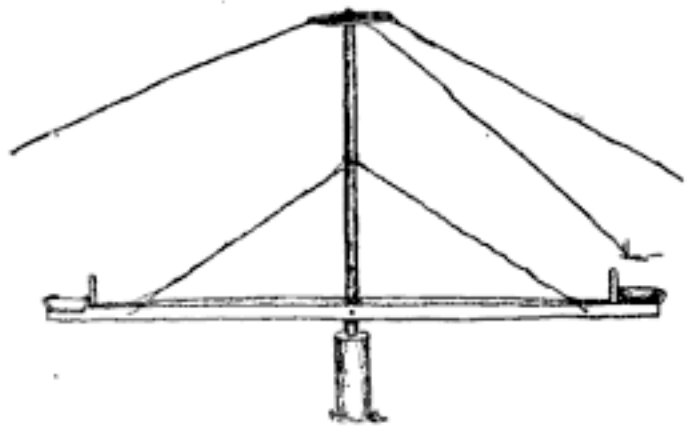
Fig. 1 shows the screws and spring arranged on the base; Fig. 2 shows the position of the wooden base above the door, and shows a complete plan of the wiring.—Contributed by Harry A. Peshon, 333 Cherry St., San Francisco, Cal.

## SIMPLE X-RAY EXPERIMENT

The outlines of the bones of the hand may be seen by holding a piece of rice paper before the eyes and placing the spare hand about 12 in. back of the rice paper and before a bright light. The bony structure will be clearly distinguishable.—Contributed by G. J. Tress, 126 Centre Ave., Emsworth, Pa.

## TO BUILD A MERRY-GO-ROUND

This is a very simple device, but one that will afford any amount of amusement. The center post rests in an auger hole bored in an old stump or in a post set in the ground. The stump makes the best support. The



Home-Made Merry-Go-Round

center pole should be 10 ft. high. An old wheel is mounted at the top of the pole, and the pole works in the wheel as an axle, says the American Boy. The wheel is anchored out by several guy wires. The seat arms may be any length desired. A passenger rides in each seat and the motorman takes his station at the middle.

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the age of air ships, submarine boats and wireless telegraphy. Designed for and adapted to the particular wants of bankers, accountants, mechanics, farmers, manufacturers, merchants, miners, etc., etc., and must prove of incalculable value to them—unless the book itself can calculate its own worth—for it calculates almost everything that is calculable.

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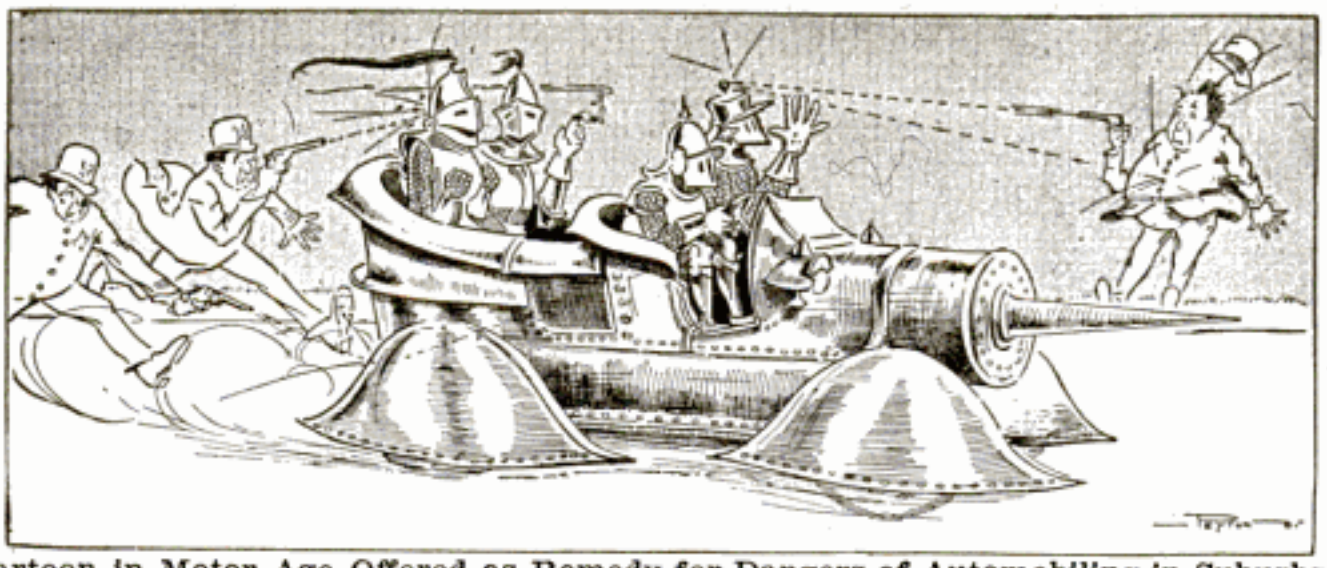

Cartoon in Motor Age Offered as Remedy for Dangers of Automobiling in Suburbs of Chicago, Where Policemen Stop Fast Riding by Shooting Holes in the Tires.

## KNOTS AND MILES

There is a growing practice, says the Yachtsman's Guide, of making an improper use of the word knot, not only with landsmen, engineers and shipbuilders, but also with those who should know better. The prevailing idea appears to be that a knot is the same as the geographical, nautical or sea mile, and the word knot is used to prevent any possible confusion with the statute land mile. But this is quite wrong. The knot is the cosmopolitan unit of speed, employed at sea by sailors of all civilized nations. One knot is a speed of one nautical mile an hour, the nautical being the mean sexagesimal minute of latitude on the earth's surface, so that it is 90 x 60—5,400 miles from the equator to the pole, and this is the only mile the sailor knows or uses. The nautical mile is a little over 6,080 feet, the Admiralty measured mile (we do not say the Admiralty knot), so that one knot is a speed of a little more than 100 feet in a minute, more nearly 101 to 102 feet a minute; thus, on a log line, with a half minute glass or interval of time, the distance between the knots should be 50 feet or a little over, say 51 feet.

The word knot is derived from knots on the log line, the number of knots that pass over the ship's taffrail during a half minute or other interval of time, giving the speed of the ship in knots. The only occasion then, on which it is permissible to use the word knot as the equivalent of a length is in tracing the knots on the log line, and then, by a familiar tendency in language, the "distance between two knots" is abbreviated in speech to the "length of knots." By a curious perversity and straining after precision, the incorrect expression "knot an hour," to express the speed of a ship, is creeping into general use, with the effect of displacing the word mile by knot. No real sailor would say that a rock on the land was half a knot, one knot, etc., away. It is too often urged that the expression "knots an hour" is so much clearer and definite; but we might just as well measure pressure in "atmospheres per square inch."



## BURGLARS

"James," cried Mrs. Timmid, "there are burglars downstairs."

"Oh, no, there ain't, my dear," replied Mr. Timmid.

"I'm sure there are."

"I'm sure there ain't."

"I tell you there are."

"I tell you there ain't."

"Your husband is right, mum," interposed a low-browed individual who thrust his head into the room at this juncture. "We're upstairs."

And as he started down he was heard to say to his pal, "I always believe in helping a husband out whenever I kin. I'm a married man myself."—Pittsburg Post.

## A CUREALL.

[From the Catholic Standard and Times.]

Feelin' pretty blue, you say?
Ha! ha! ha!
Things went wrong with you today?
Ha! ha! ha!
One would think, to see you frown,
All the troubles in the town
Clung to you and weighed you down.
Ha! ha! ha!

Come now, mister, don't get mad.
Ha! ha! ha!
I ain't laughin' cause you're sad,
Ha! ha! ha!
I've had troubles, too, today—
Bad as yours, I'll bet—but, say,
I'm a-drivin' 'em away.
Ha! ha! ha!

Grandest tonic on this earth—
Ha! ha! ha!
Is a steady dose o' mirth.
Ha! ha! ha!
Just you get a strangle hold
On your cares an' knock 'em cold
With a hearty, merry, old
Ha! ha! ha!

## ESSENTIAL QUALITIES OF A SUCCESSFUL LOCOMOTIVE ENGINEER.

"Three qualities are most essential for an engineer to possess in order to make a success of running an engine: First, a fairly good education; second, a reasonable amount of practical experience as a fireman, three years at least; and third, good judgment." So writes W. J. Hill in an article from which the following is condensed:

Probably the third is the most necessary of the three, as many men who have had the education and the experience, have failed to make a success of running because they lacked good judgment. A fireman frequently has chances of measuring his capacity along this line, by watching the outcome of things which his engineer does, and which at the moment he thinks is wrong or unnecessary. The engineer applies his brake some distance from a fixed signal, or before rounding a curve, or when entering a yard when everything is apparently clear. If he watches the case to the end, he will likely find that the engineer's past experience has taught him the signal is liable to be changed at the last moment; find someone's tail end just around the curve, or a yard engine working down in the yard which may run out in front of him at

any moment. The man with good judgment realizes how many of our wrecks are caused by the failure of yard engines and others to be in to clear, or by tail ends not protected, and he takes precaution accordingly. Frequently men take long chances in order to make the time, but generally the man who does, sooner or later gets caught. Again, good judgment is required in case of a breakdown. A man must think quickly whether the engine can be readily repaired and take in the train, or whether another engine must be sent for, also what must be disconnected or can be left as it is, until the engine is off the main line into a siding.

Read books on mechanical or scientific subjects. Acquire habits of study, and instead of regretting that you did not get a good education when you were young, embrace some of the opportunities which every man has today, through correspondence schools, night schools, or other technical schools. Start at once, so that five years from now you will not still be regretting that you did not enlist in 1905. Get busy, and remember you are never too old to learn if you persevere.

It is not the engineer who makes a successful trip with a good engine, good coal and weather conditions in his favor who displays his ability as an engineer. Any kind of an engineman could do that, but it is the man who can go out on the road and successfully take a train from terminal to terminal with a leaky engine, poor coal and other adverse conditions which are common today, who shows that he is an engineer "of the first water" and entitled to his company's confidence.

Some time ago a magazine sent letters to a number of high railway officials asking them if they gave preference to college graduates in filling vacancies in the various departments. Nearly all the men thus written to replied that they preferred men who had at least a thorough public school training, or, better still, a technical education, owing to the fact that these men had been trained to study; their minds were more active, thus being better fitted for an emergency.

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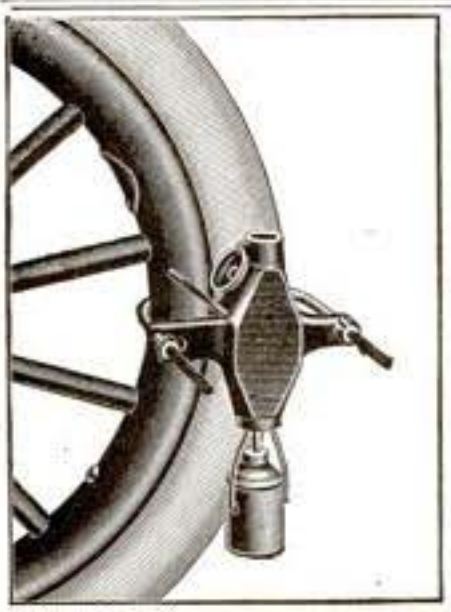

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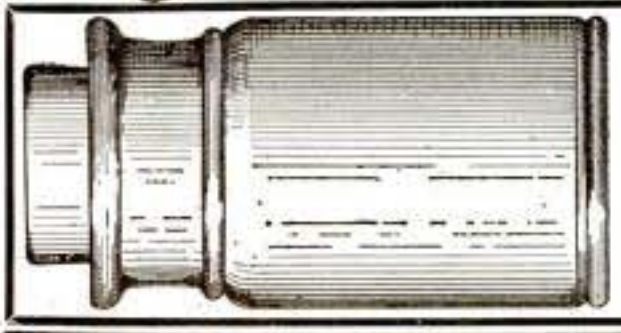

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**54 DEY STREET, N. Y.**

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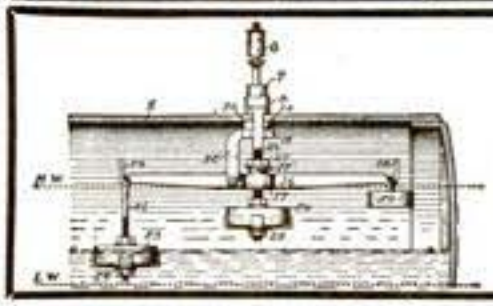

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High and low water and high pressure alarm for steam boilers. Whistles when water is too high, too low or for high pressure. The floats are made of terra cotta, will not collapse or fill with water. Will work at any boiler pressure. Sent on approval. You can try it before you purchase. Mechanical agents wanted everywhere. For full particulars and descriptive circulars, address

GEORGE LANCASTER. - 541 Lexington Ave. - NEW YORK CITY

## TOGO THE MODEST.

A nation called a fighting man,
He didn't say a word.
He listened close to aim and plan,
He didn't say a word.
"Togo," they said, "within your hand
Is held the future of our land."
His nod replied, "I understand."
He didn't say a word.

He climbed aboard his battleship
And didn't say a word,
He found the foes he went to whip,
And didn't say a word,
But plugged them full of smoking lead
And hammered till the sea turned red,
And when they all were sunk or fled
He didn't say a word.

The battle won, the country saved,
He doesn't say a word.
In lasting fame his name engraved,
He doesn't say a word.
His glorious health the whole world drinks,
He smiles a little, nods and winks,
And, like that wise old bird, the Sphinx,
He doesn't say a word.

—Newark News.

## NEW MECHANICAL DEVICES.

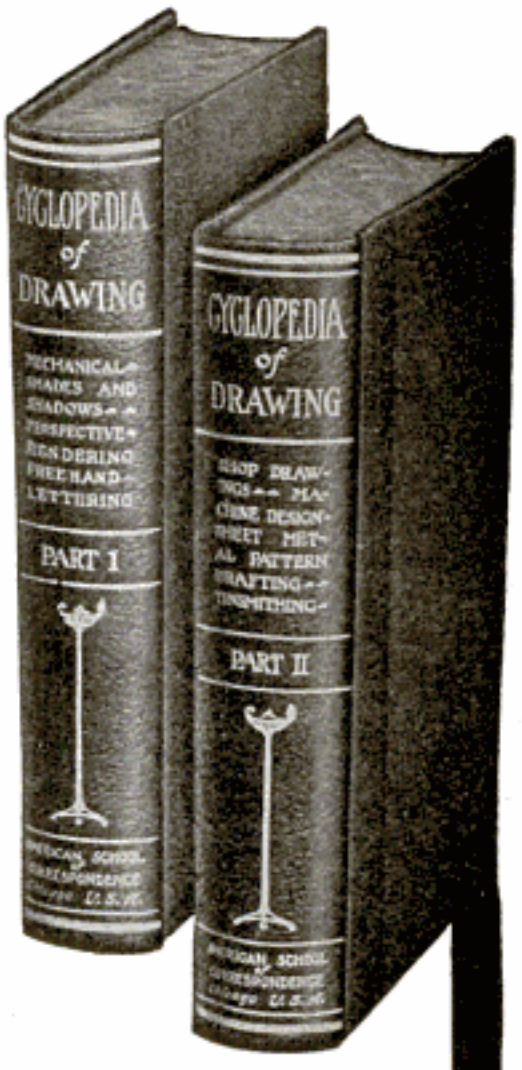
**ROPE CLIMBER.**—This device will be best understood from the illustration. When the rope is grasped by the hands and the feet raised, the jaws of the climber open, allowing it to slip up the rope freely. The moment the feet are pressed down the

jaws close, gripping the rope and affording a secure support to the operator. A very long rope may be climbed in this way, as the climber can stop for rest as long and often as desired; or having reached the elevation sought can use the hands for other work while standing in the climber.

**STEAM WALL-PAPER REMOVER.**—Steam generated in a boiler by means of a gasoline burner is applied to the wall by a hood in the hands of the workman. The hood is connected to the boiler by rubber tubing. When the hood has been held to the

wall a short time the old paper readily peels off by the use of a plow. The outfit is portable and the gasoline tank is of capacity for a half day's work. The water tank holds four gallons, sufficient for the same period. The steam kills any germs or vermin that may be in the wall, also.

# Cyclopedia of Drawing

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A new enlarged edition, constituting a complete encyclopedia of information on Drawing, has just been issued for the library, the shop, drafting room; teacher, student and all others interested in this fascinating subject.

The set is published in two handsome volumes, bound in ½ red morocco. It contains over 1200 pages (8 x 10 inches), completely indexed and beautifully illustrated with 1500 illustrations, line drawings, half tone engravings, full page and folding plates, tables, etc.

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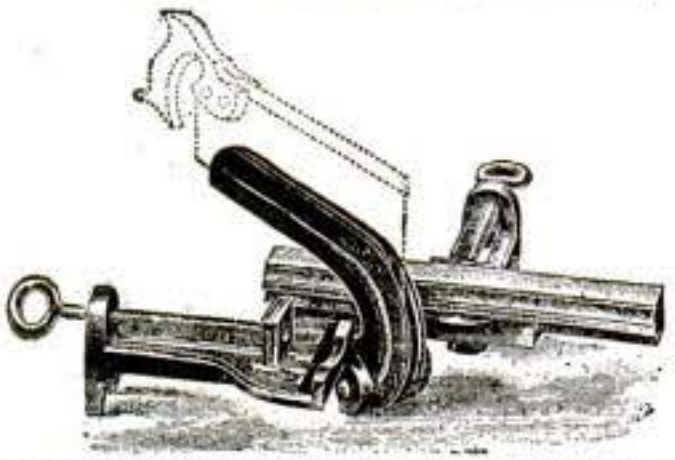
**Mitre-Cutting Tool.**—A combined mitre-cutting block and corner cramp, especially for making pic-



ture frames and similar work. A recent English invention. Will hold mouldings up to 4½ in. wide.

**SEARCHLIGHT CLUB:**—A new electrical device is a policeman's club with an electric searchlight in the end which can be made to flash by pressing a button in the handle. One would naturally expect a blow from such a club to be light, but the contrary is true, as it contains a battery, and altogether is quite a shocking affair.

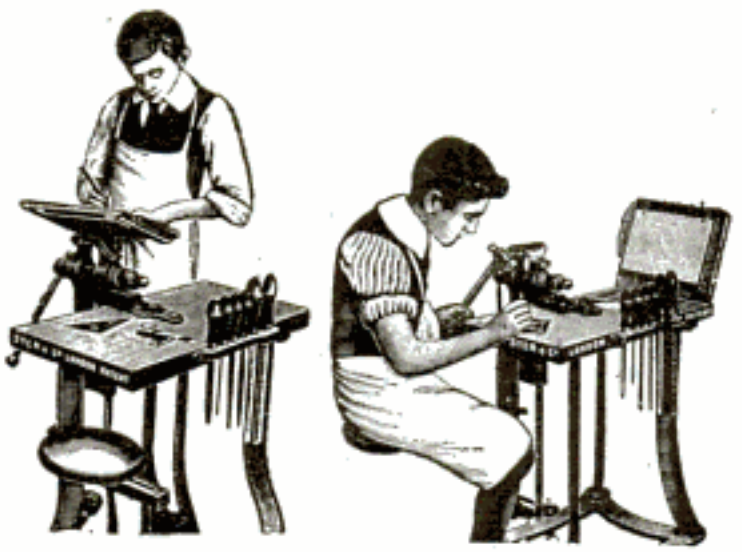
**HEAT AND LIGHT GAS BURNER.**—Attaches to chandelier, wall bracket or portable gas stand.

Easy to adjust. When lighted produces both heat and light at one cost. Clean and odorless.

**Expansion Drill for Iron.**—A new English device which cuts holes up to 3 in. diameter. Intended specially for plumbers and hot water engi-

neers. Obviates the cutting of a circle of small holes; only one small hole—the center—is required to use the drill. The claim is that a 1½-in. hole can be drilled through $\frac{3}{16}$-iron in five minutes.

**New Bench Vise.**—An English device specially intended for use in manual training schools. Contains in addition to the ordinary vise, a drawing



table, seat, rack for files and compartments for tools, and drawer for drawing instruments.

**"Next Street" Indicator.**—A mechanical device for announcing the next street or station in street or passenger cars. Consists of a box 8 in.


high by 24 in. long, operated by a bell cord and illuminated at night by an electric lamp inside the box.

**Automobile Rules.**—Grab der veel vich is in front of you firmly mit both hands and put one foot on der accelerator. Now put der udder on der rheostat und let der elbow chently touch der deodizer. Keep der blow pipe connecting mit der automatic fog vissle closely between der teeth, und let der right elbow be in touch mit der quadruplex while der apex of der left knee was pressed against der spark coil. Keep both eyes on der road in front of you und der rest of your face in der vaggon. Start der driving wheels, repeat slowly der name of your favorite coroner, und leave der rest to fate.—Whitewater (Wis.) Register.

**Glass Churns for Home Use.**—The glass churn comes in small sizes and is intended for converting the small quantities of milk and cream that may not be used and will sour if left over into wholesome butter. The churn has a small wooden paddle that is easily rotated and seven or eight minutes of churning suffices.

The churn can be operated by an inexperienced child, and the little pats of home-made butter amply repay for the extra trouble.

## HEIGHT AND SPEED OF WAVES

The subject of the height and velocity of the waves of the ocean is always an interesting one, and frequently comes up for discussion by landsmen as well as seamen. It has been calculated that waves rarely exceed a height of 40 feet, while the speed at which they travel depends largely upon the wind and depth of the water. Airy calculates that a wave 100 feet in breadth and in water 100 feet deep travels at the rate of about 15 miles an hour; one 1,000 feet broad and in water 1,000 feet deep at the rate of 48 miles; one of 10,000 feet in breadth and in water 10,000 feet deep will sweep forward with the velocity of not less than 154 miles an hour. An earthquake on the Island of Niphon, Japan, caused a wave to travel 4,800 miles across the Pacific to San Francisco in 12 hours and 16 minutes, or at the rate of 6⅔ miles a minute. Waves of the Atlantic have been calculated to move at the rate of 32.67 English miles an hour.

## THE MAN WHO'S AFRAID

I've paid close heed to the ways of men,
  I've observed what the world calls luck,
I have silently marveled, now and then,
  At the potent power of pluck;
And this as a bit of truth I hail,
  A sentence that's worth one's heed;
The man who is always afraid he'll fail
  Doesn't stand much show to succeed!

—Dividends.

# 4 SMOOTH PERFECT EASY SHAVES for 1c

BY THE USE OF THE **MORTON SAFETY RAZOR**

ONE PIECE HANDLE and BLADE

FULL SIZE

TRIPLE SILVER PLATED

There are twelve double-edged blades or twenty-four cutting edges of the finest, smoothest, hardest steel, ground by our own process to a lasting, perfect edge. They are tempered so hard they will cut glass, and each one of these blades will give 20 to 40 smooth, perfect, easy shaves, no matter how harsh the beard, with

## NO HONING OR STROPPING

A set of new blades will cost $1.00—so you can see how you can get 300 to 500 shaves for $1.00, or an average of about four shaves for a cent.


Exact Size of Blade.

The safety razor has become popular, and self-shaving is now a part of every gentleman's education. It has remained for the MORTON to develop to the highest point, where others have experimented. Its construction is so simple that it cannot get out of order, and any one can use it. There are only two pieces—handle and blade. The blade slips into the handle without screws, clasps, hinges, or other movable parts. **With the MORTON cutting the face is impossible.**

## PROVE ALL THIS BY A TRIAL AT OUR EXPENSE

Use the MORTON thirty days and if for any reason you want your money back, just return the razor and we will return your money without question. We pay express charges both ways. We authorize all dealers to make this offer. If yours don't handle the MORTON write us for our interesting booklet, but be sure he doesn't induce you to try "some other" kind. There is no other razor "just as good."

**MORTON SAFETY RAZOR CO.** 1192 Tacoma Building, Chicago, Ill., U. S. A.

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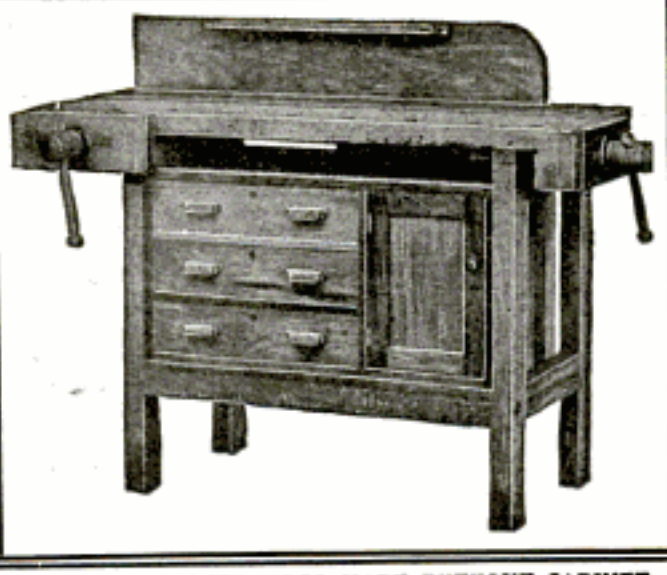
# Home Benches



THE NO. 42 BENCH; ALSO MADE WITHOUT CABINET

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**GRAND RAPIDS HAND SCREW CO.**

146 South Ionia Street

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Largest Manufacturers of Manual Training and Home Benches in the World.

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We Manufacture and Market Patented Specialties

We have had Experience

Youprobably Have not

Send us Description of Your Invention

It will have careful consideration

Should we think it unsuitable for our purposes, all papers will be returned

**POWER SPECIALTY CO.**

513½ WASHINGTON ARCADE

Detroit, Michigan

## QUICK HANDLING OF MAILS ON THE ROCK ISLAND ROAD

A satisfactory device for discharging mails from high-speed trains, for which postoffice officials have been searching for more than seven years, has at last been discovered and following repeated tests, is now in daily use on one of the Rock Island's fast mail trains in Iowa.

Captain E. L. West, superintendent of the railway mail service, Chicago, and other postoffice officials who have witnessed the workings of the new device, are enthusiastic over the results accomplished. Equally good performance is shown on trains running at from fifteen to as high as seventy-two miles per hour.

The operation of the mail crane for picking up mails is familiar but the problem of discharging mails safely from the same trains, without hazard to the mails, trains and bystanders, has been a difficult one. A special commission appointed by the postmaster general, in 1902, to examine the various devices offered the department, made thorough tests of eighteen different devices and reported, in May, 1902, rejecting all of them as having one or more points of impracticability.

The Burr delivering device was among those examined, but the objections entered against it have been overcome. The device is entirely automatic and is operated by air from the brakes of the train and the instantaneous action necessary, is thus secured.

The device consists of a platform arranged in the car door, on which the sacks of mail to be delivered are placed. Contact between the crane on the station platform and a trigger on the mail-catching arm on the car, puts the mechanism in operation, which ejects the mail sacks into a receiving box placed at the side of the track, so constructed that the air is forced into either end by the momentum of the pouch and thus acts as a cushion, preventing damage to the pouch or its contents. The Burr device, combined with the standard crane, can be operated either to catch or deliver mail.

The Rock Island has done much in the past few years to facilitate western mail service and in affording opportunity for development of the Burr mail-catching and delivering device, has given valuable aid to the postoffice department and the commercial interests of the country.

# Nature's Coffee Pot

*'Makes Coffee Harmless."*

We have at last discovered the active principles of separating the pure Coffee extract from the bitter and poisonous matter of the Coffee Bean.

Like all great inventions—it is simple; so simple indeed that it seems impossible that it was not thought of before. We want to tell you more about this Coffee Pot—it's wonderful workings and the clever way it transposes Coffee into a drink—as healthy and harmless—as a glass of water.

## Try This Coffee Pot at Our Expense

Talk is cheap—let us show you the proof by sending you a Nature's Coffee Pot. We want you to test it for yourself in your own home. Send us no money until you are satisfied—then mail us a dollar or send us back the Pot. This is our way of doing business.

THE POILLON POTTERIES, Branch No. 3, Woodridge, N.J.


Catalog Free.

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Get started early.

**$40 to $75 A WEEK**

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**Steam Peanut Roasters and Corn Poppers**

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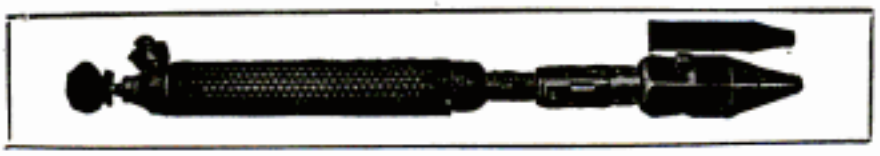
Send me your name and address and I will send you by return mail, postpaid, free (nothing for you to pay) one of my latest new secret process, beautiful colored stereoscopic views. I will also send you my new price list of stereoscopes and views of all kinds, war views, scenery, famous places, St. Louis Fair views, Bible scenes, comic views, funny scenes, etc., all wonderful offers that will delight you.

ROBERTS SPECIALTY COMPANY, BOYCE BUILDING, CHICAGO, ILL.

## GASOLINE SOLDERING IRON AND BLOW TORCH



Furnished with two coppers drop forged from bar, one for regular work and one for heavy work. Nothing complicated. No pump to get out of order. No platinum coil to burn out. Never too hot and never too cold. No wind will blow it out. Can be changed to blow torch instantly. Can be carried in any tool kit, or lineman's belt. Will last for years. Used by tinners, plumbers, painters and electricians. Guaranteed to give satisfaction. If your jobber does not handle them, write us for illustrated booklet and price.

EMMELMANN BROS. MFG. COMPANY, Indianapolis, Ind., U. S. A.

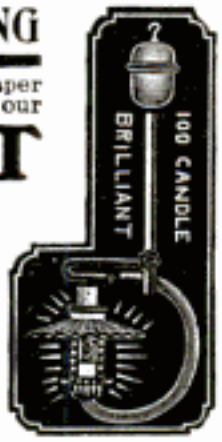
## COUNTRY HOME LIGHTING

Made effective, easy and 50 to 75 per cent cheaper than kerosene, gas or electric lights by using our

# BRILLIANT

OR

## Head Light Gasoline Lamps




They can be used anywhere by anyone for any purpose, business or house use, in or out door. Over 100,000 in daily use during the last 8 years. Every lamp guaranteed. Write for P. M. catalog, it tells all about them and our Gasoline Systems.

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42 State St. Chicago, Ill.

**$5.00 a month to one bright man in each good-sized shop. Does not interfere with regular work in the least. Address "Opportunity," Room 510—160 Washington St., Chicago.**

## $15.00 LIST REFRIGERATORS $6.21

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Price less than cost to manufacture

White Enamel Lined, Zinc Lined
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Cold Air Space

Our prices $5.00 to $8.00 Less than Department Stores

SENT ANYWHERE C. O. D. SUBJECT TO APPROVAL

**Tolman Steel Range Co.**
66 Lake Street, Chicago

## SMALLEST COMPLETE FARM IN THE WORLD.

California can truthfully boast of having the smallest complete and most profitable (for its size) farm in the world. It is located in the great valley of the Sacramento, near the little town of Orland. This farm consists of just one square acre. It belongs to Samuel C. Cleek, who, assisted by his wife, has continuously cultivated this diminutive ranch for 27 years. Originally, the acre was part of a wheat field, and was dry and semi-barren, having no running water. Cleek sunk two wells from which he obtained an abundant supply of water. He has converted the arid farm into a perfect gem of beauty, fragrance, and profit. Not only has this acre supported the couple, in comfort and even luxury, but has yielded an income, and $4,000 has been placed in the bank—derived from the profits of production.

Mr. Cleek first settled on the wee sterile tract, when he and his good wife were very poor. Through patience and judicious toil, the couple have made the land literally "to bloom and blossom as the rose." This farm contains: Cottage and porch, 30 by 30 ft.; barn and corral space, including chicken coops, etc., 75 by 75 ft.; two windmill towers, 16 by 16 ft. each; garden, 46 by 94 ft.; strawberries, 65 by 90 ft.; citrus nursery, 90 by 98 ft.; in which there are 400 budded orange trees; a row of dewberries along the fence, 100 by 2 ft.; four apricot, two oak trees, three peach trees; seven eucalyptus trees; six fig trees; ten locust trees; one paradise tree, four bearing bread trees; thirty rose bushes; twenty geraniums; twelve lemon trees; a large lime tree from which was sold the present year 160 dozen limes; eight bearing orange trees; five pomegranate trees; six beds of violets, 6 by 2 ft. each; one patch of Japanese bamboo; one bed of calla lilies; four prune trees; six cyprus trees; fourteen stands of bees; four huge grapevines; one bed of sage; one large garden and flower seed bed, besides honeysuckle, and a great many other rare and beautiful exotic plants and shrubs. In some of the little spare corners and angles, vegetables are cultivated with much success; so that with the exception of flour for bread, and a few groceries, this little "One Acre Farm," produces all that Cleek and his wife can consume, and a great deal more—leaving a considerable surplus that is marketed to profit every season. This demonstrates what may be produced on just one acre of even rather poor land when it is industriously cultivated.

**The "1906 Shop Notes" will be ready December 1st. Price 50c.**

## STEEL FENCE, WHY NOT STEEL POST?

### Argument in Favor of Steel Fence Post—Protects Against Lightning

By L. C. Sharp

Being considerably interested in fence post construction, I note with interest an article in your July issue by T. H. Pottinger, of Peru, Ill., relative to the various good points inherent in cement construction for fence posts. I have given this matter considerable thought and have arrived at a different conclusion, and think that the coming post for farmers will be made of metal. It is conceded by all observers in this line that the old wooden post must go, and the reasons are plentiful why this should be so. While the advantages of cement posts, as enumerated by your correspondent, are evident, they are not enough to warrant the assumption that concrete has sufficient advantages to make it the coming post.

In regard to cement construction, it is not every farmer who cares to bother with or comprehends the mixing of cements and casting in moulds; then again, the constituents of a perfect cement mixture are not easily obtainable in all localities. On the other hand, if the posts are factory-made, the excessive weight and their fragile nature brings them into a classification in shipment which makes a prohibitive price on them; furthermore the stringing of wires and stay plates in the interior introduces additional expense and weakness in the posts.

As to the cement being a protection against lightning, I do not see how this can be, as seasoned cement is a non-conductor, as much so as wood. It is now well understood that it is of the highest importance that all fence wires be grounded with the earth, in order that stock may be protected from this dangerous source of loss. The electric discharge will escape always through the path of least resistance, which is often through the bodies of stock and animals which invariably drift up against the fences during storms. How often do we hear of whole herds being stricken down in this manner! I have noted but recently the event of

(Continued on page 1076.)

100 horses being killed by lightning at Rapid City, S. D., on account of a non-protected wire fence, and of 40 head of cattle killed by lightning in Iowa, and so on more or less, all over the country. This point alone is worthy of the most careful consideration and is something which can only be prevented by thorough grounding of the wires, only to be accomplished by giving each wire a metal path to the earth.

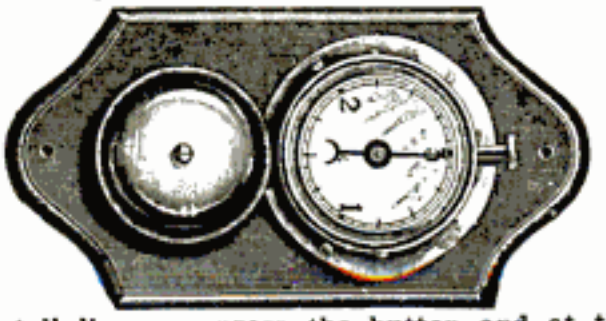
Aside from the deficiencies mentioned in the concrete post, there is the additional expense and time involved in the digging of post holes, tamping, and the annoyance of long staples for each fastening. It would seem to the writer, viewing the relative merits of each, that the selection should largely preponderate in favor of the rust-proofed iron and of such a form as shown in the advertising pages of this magazine. In this construction lies the greatest strength with the least amount of material; there is no post holes to dig, nor staples used. It would seem to the undersigned that there is as much consistency in using metal for the post as metal for the wires. One should last as long as the other, and the posts, when past their stage of usefulness, are still valuable as scrap. I therefore believe that the metal post is the proper thing, being, as it is, rustless, lightning-proof, fire-proof, frost-proof, requiring no staples to use, nor holes to dig, and giving absolute uniformity and at low cost.

Omaha, Neb.

## TIN PLATE PROCESS 400 YEARS OLD

Making tin plates, or the process of coating iron with tin, was invented in Germany about 400 years ago. The people of that country kept the process a secret for over a century, but after a long and diligent search English manufacturers, near the end of the seventeenth century, discovered the secret. In England, soon after this discovery was made, the process of rolling iron sheets was invented, the tin plate industry growing rapidly, and for nearly two centuries England maintained its supremacy in the industry, until about ten years ago, when our country became a strong rival.

TELEPHONE CLOCK.—To be placed over or near a telephone. When commencing conversation



on a toll line you press the button and at the expiration of the three minutes an alarm bell sounds.

## NEW BOOKS.

**PRACTICAL PLUMBERS' WORK.** Edited by Paul N. Hasluck. Numerous illustrations; 160 pages; crown 8vo.; cloth, $1.00. David McKay, Philadelphia.

This practical volume treats first the materials and tools used by plumbers, and then, step by step, in a manner readily understood, carries the subject through its several practical applications. The text is elucidated by illustrations. Among other subjects treated are sheet lead working, pipe bending, pipe jointing, lead burning and lead work on roofs.

**CLAY MODELING AND PLASTER CASTING.** Edited by Paul N. Hasluck. Illustrated; 160 pages; cloth, 50 cents. David McKay, Philadelphia.

This little book is intended for the use of the beginner and its text and illustrations are purely adapted to his requirements. It treats of drawing for modelers, tools and materials for clay modeling, clay modeling, modeling ornaments, modeling the human figure, casting in plaster from nature, finishing casts, etc.

## WANTED

We want the names and addresses of parties who have small factories and who are looking for new things to make in their lines. Anyone sending us the names and addresses of such parties will be compensated for their trouble. Popular Mechanics Patent Bureau, Journal Bldg., Chicago.

## TO OUR FRIENDS

If you have an acquaintance who has an invention and wants to know:—

1. Whether he can get a patent.
2. How much it will cost him to get a patent.
3. Whether it will pay him to get a patent.
4. How he can sell the patent after he gets it.
5. How he can get the most money out of his invention.

Tell him to write to Popular Mechanics Patent Bureau, Journal Bldg., Chicago, Ill., for free advice and information. Then write to the Bureau, and give the name and address of the inventor. You will be peased with the results.

## NEW CATALOGS.

OLDSMOBILE is the title of an attractive catalog issued by the Olds Motor Works of Detroit, Mich. The book illustrates the various machines of the company's make, stating the merits and particular adaptations of each and its price. There is a good deal of information on autos, incidentally.

DUMP CARS were invented in 1866. In their recent catalog under this title the Kilgore-Peteler Company of Minneapolis, Minn., illustrate and describe the dump cars of 1905, up-to-date in every respect.

MECHANICAL DRAWING.—Samples of the instruction plates used by the Grand Rapids School of Mechanical Drawing, Grand Rapids, Mich., illustrate in handsome manner the practicability of this system and likewise its simplicity. The student passes from one lesson to another without difficulty, so carefully has their sequence been arranged. Definitions and propositions appear in as brief form as possible and in all respects the task before the pupil has been greatly simplified.

ELECTRIC MOTORS AND DYNAMOS is the subject treated of in Bulletin No. 4 of the Barriett Electric Company. Several types of Barriett motors and dynamos are illustrated and described in detail. A portrait of S. L. Barriett, the inventor of the self-oiling bearing and the automatic release starting rheostat, is one of the features of the book.

## HYDRAULIC DRAIN JOINTER.

This drain jointer which is an English device is described in the London Plumber as consisting of a pair of rubber discs mounted on a sliding piston connected to a cylinder, into which water is pumped under pressure, and by which pressure the two discs are brought close together. The appliance is placed in the entrance or opening of a drain, the space between the discs then filled with Portland cement wet to a plastic condition, and then dragged into the drain by means of a rope and a special hauling lever.

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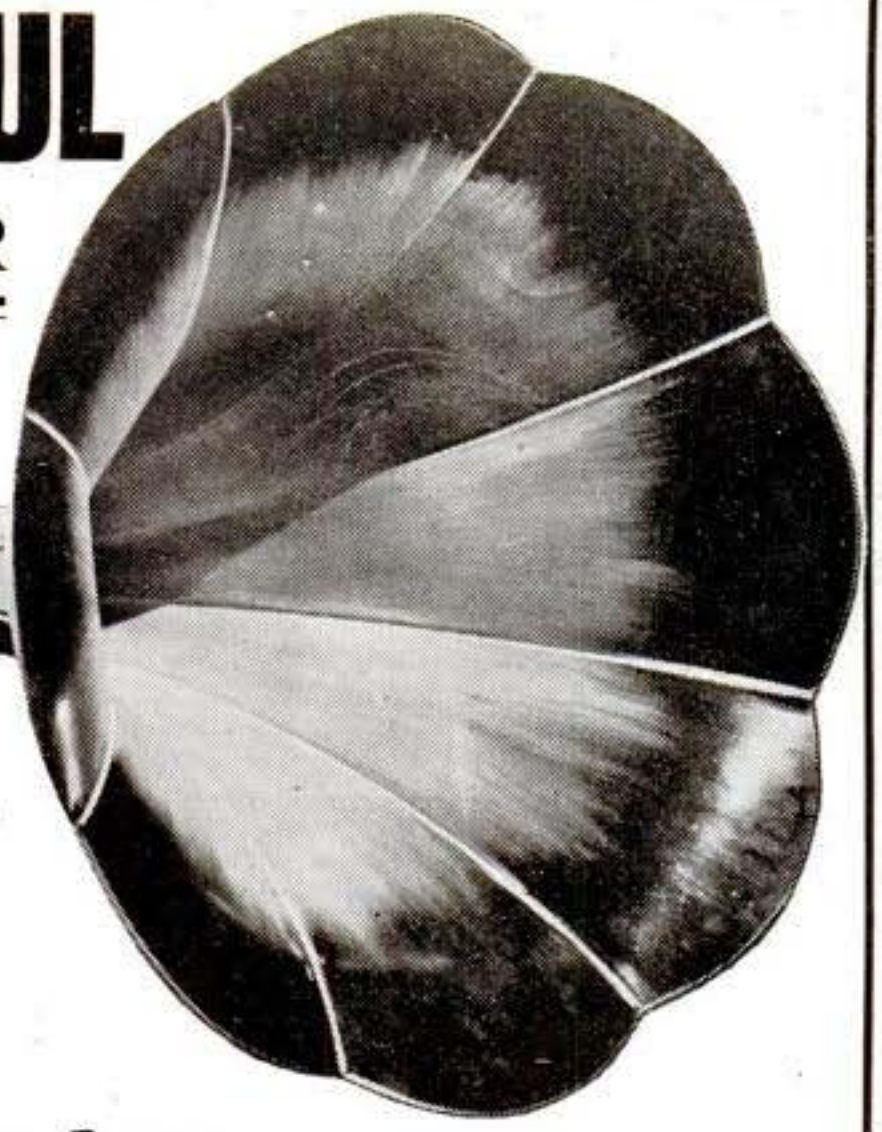

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